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THE NATIONAL ACADEMY OF SCIENCES[1]

PRESENTATION OF THE AGASSIZ MEDAL TO FRANK RATTRAY LILLIE[2]

IN these times of exaggerated nationalism it is fortunate that we can still emphasize the internationalism of science. The Murray Fund of the National Academy of Sciences is peculiarly international in its foundation and purpose. It was established in 1911 by Sir John Murray, Canadian by birth, Scot by adoption, internationalist in science, to honor the memory of Alexander Agassiz, Swiss-born American, cosmopolitan as the ocean in his research work. Of the seventeen awards of the Agassiz Medal which have been made hitherto, fourteen were given to foreign oceanographers, three to American. Of the foreign awards, five went to Norwegians, two to Swedes, two to Danes, two to Britons and one each to oceanographers of Holland, Germany and Monaco.

The eighteenth award of this medal is to one who is a Canadian by birth, American by adoption and an internationalist in his sympathies and services, Frank Rattray Lillie, thirteenth president of the National Academy of Sciences. For twenty-six years he was director of the Marine Biological Laboratory at Woods Hole, Mass., and he was president of that institution from 1926 to 1939. During nearly half a century his research activities have been largely associated with marine biology and particularly with normal and experimental embryology and cytology, problems of fertilization and parthenogenesis, and during all these years he has stimulated or directed the research work of many hundreds of investigators. The Marine Biological Laboratory, one of the greatest institutions of its kind in the world, in large part owes its physical plant, its financial endowments and, best of all, its stimulating and cooperative atmosphere to his wise guidance and friendly supervision.

[1] Meeting at Washington, D. C., April 22 and 23.

[2] The presentation of medals was made at the annual dinner, April 23.

Recognizing the needs of the more extensive cultivation of the wide field of oceanography, he conferred with the late Dr. Wickliffe Rose, president of the General Education Board, on the needs of a more comprehensive provision for research in this science, and at the annual meeting of the academy in 1927 he introduced a resolution, "that the president of the academy appoint a committee on oceanography from the sections of the academy concerned to consider the share of the United States in a world-wide program of oceanographic research." The members appointed were William Bowie, E. G. Conklin, B. M. Duggar, John C. Merriam, T. Wayland Vaughan and F. R. Lillie, *chairman*.

The following year, through the efforts of Dr. Lillie and Wickliffe Rose, the General Education Board made a grant of $75,000 to finance a thorough study of the problems as well as the needs of a comprehensive program of oceanography. Dr. Henry B. Bigelow was appointed secretary of the committee on oceanography to collect information and prepare a report on the present status of this science in America and Europe. This report was presented to the academy and to the Rockefeller Foundation and was later published in a volume of 263 pages. At the same time T. Wayland Vaughan made a special study of the status of oceanography in the Pacific area, and ultimately extended this to a survey of the "International Aspects of Oceanography," which was published in a quarto volume of 225 pages in 1937 with funds remaining from the original grant of the General Education Board.

After Dr. Bigelow's report had been carefully considered and generally approved and the decision had been reached to establish a central oceanographic station at the most suitable place on the Atlantic coast, the Woods Hole Oceanographic Institution was incorporated in 1930 and its board of trustees petitioned the Rockefeller Foundation for funds for building, equipment, research ship and endowment; one month later the foundation granted $2,000,000 for this purpose and later added $1,000,000 to the endowment.

As a member of the committee on oceanography and of the board of trustees, I know how much of all this success was due to the efforts of Dr. Lillie, and how little to the rest of those whose names were associated with his.

Dr. Lillie served as president of the Woods Hole Oceanographic Institution from its incorporation until his retirement at his own request last summer, when Dr. Bigelow, who had been director from the time of its foundation, was chosen president. In all this labor of awakening interest in oceanography, in securing large endowment, in building and equipping the station and in organizing its main lines of research, Dr. Lillie took the leading part ably seconded by Dr. Bigelow.

This is the leading privately endowed oceanographic institution in the world. Already it has drawn to itself many of the leading oceanographers of the world. Its research ship, the *Atlantis*, has sailed more than 150,000 miles on research voyages; more than 240 research papers and monographs have been published from the institution since its foundation. The National Academy of Sciences may well be proud of the fact that it took so important a part in sponsoring this notable institution, without any cost to itself.

For his important researches and his wise leadership in marine biology, for his enduring contributions to the science of oceanography in the founding and endowing of the Woods Hole Oceanographic Institution, for his modest but effective leadership in causing this country to assume its share in a world-wide program of oceanographic research, the committee on the Murray Fund presents to you, Mr. President, for the eighteenth award of the Agassiz Medal, Frank Rattray Lillie.

EDWIN G. CONKLIN

RESPONSE BY THE MEDALIST

THE chairman of the committee on the Murray Fund has stated so fully the reasons why I should be the recipient of this honored award that I hardly need to enter a disclaimer for the association of my name with the list of those who have previously been honored with this award—all distinguished and original contributors to the field of the ocean sciences. But I wish personally to emphasize the fact that I stand here this evening in a representative rather than in a personal capacity. The accomplishments have been, indeed, the work of many minds and hearts.

The roots of this occasion are bedded in the history of oceanography in America. They were planted by early seamen and navigators, and cultivated in the early surveys under our federal government, which called the first international conference for a uniform system of observations at sea held in Brussels in 1853. Lieutenant M. F. Maury, of the United States Navy, who had been instrumental in devising the first "Winds and Currents" charts of the oceans, summarized the scientific knowledge of the oceans up to 1855 in his classical work on "The Physical Geography of the Sea," in which he attempted to lay down a "system of philosophical research with regard to the sea."

At this time America was clearly leading in the organization of oceanographic research. We lost that position for many years in spite of much excellent detailed work by federal agencies, and by individuals, such as the former president of the academy, Alexander Agassiz. During this period a new and more comprehensive oceanography arose in Europe, and was organized under an International Council beginning about the first of the century, based quite largely on

common economic needs of European nations. An International Committee on the Oceanography of the Pacific also was created in 1923. In spite of the economic background of these organizations in fisheries, navigation and climatology, they recognized the unity of the sciences of the ocean and promoted fundamental theoretical investigations.

At the annual meeting of the academy in 1927, the following resolution was passed: "That the president of the academy be requested to appoint a committee on oceanography from the sections of the academy concerned to consider the share of the United States of America in a world-wide program of oceanographic research, and report to the academy." The president of the academy, Professor A. A. Michaelson, thereupon appointed William Bowie, E. G. Conklin, B. M. Duggar, John C. Merriam, T. Wayland Vaughan and Frank R. Lillie, *chairman,* as members of the committee; to this list the name of Henry B. Bigelow was soon added.

Here I must digress into more personal matters. In 1891 I made my first acquaintance with the life of the ocean, at the Marine Biological Laboratory, Woods Hole, Mass. In 1910 I became director of this institution and took charge of its development with the aid and support of the very distinguished group of scientific men constituting its board of trustees, and especially of the president of the board, Mr. C. R. Crane, and later of the Rockefeller Foundation, the Carnegie Corporation and the General Education Board. By 1924 the resources of this institution were developed into a really magnificent plant for biological research, with special emphasis on life in the ocean.

During this period, about 1924, I had the privilege of becoming acquainted with that great citizen, lover of his fellow-men and of science, Wickliffe Rose, posthumous recipient of the Marcellus Hartley Public Service Medal awarded by the academy in 1931, president of the General Education Board and the International Education Board, who had acquired a deep interest in the sciences of the ocean. In the course of his travels here and abroad he became well acquainted with oceanographic work in various countries, and was deeply impressed with the economic wealth of the ocean, which he felt could be much better utilized for the welfare of nations. We had many talks on this subject which culminated in a proposal for a new central oceanographic institution in America, with estimates as to the cost of its establishment. Dr. Rose felt, however, that the plan, on account of its wide scope, needed farther study, and he suggested that if possible, the National Academy of Sciences be interested in the appointment of a committee to draw up a report similar to that previously prepared on the subject of forestry. This was the immediate stimulus for the appointment of the committee on oceanography, which was considered beforehand with the president of the Carnegie Institution, Dr. John C. Merriam, and was proposed with his advice and assistance.

Funds were provided by the General Education Board for the proposed study; Dr. Henry B. Bigelow, curator of oceanography at Harvard University, was appointed secretary of the committee; and the study of the problem was then vigorously prosecuted. The results of this study have been published in two works, one in 1931 entitled "Oceanography, its Scope, Problems and Economic Importance," by Dr. Bigelow, and the second in 1937 entitled "International Aspects of Oceanography—Oceanographic Data and Provisions for Oceanographic Research," by T. Wayland Vaughan and others.

As a result of its studies, the committee was encouraged to present a report to the Rockefeller Foundation, with a request for the establishment of a central oceanographic station on the Atlantic coast. This was the real beginning of the Woods Hole Oceanographic Institution, and in 1929, shortly after Dr. Rose's retirement, the proposal was favorably acted upon by the Rockefeller Foundation under the presidency of Max Mason, and the sum of three million dollars was appropriated for the establishment, equipment and endowment of this station. The members of the committee on oceanography became trustees of the organization, together with some other scientific men, certain public-spirited citizens, and representatives of federal departments specially concerned with problems of the ocean, and Dr. Bigelow was appointed director.

The development of the Woods Hole Oceanographic Institution proceeded rapidly and effectively under Dr. Bigelow's leadership. In accordance with the principle that a research vessel is as necessary for an oceanic institution as a telescope is for an astronomical observatory, the best possible oceanographic vessel was built in Denmark and brought to this country. This is the *Atlantis,* already famous for her explorations. The institution took as its special objective the development of the oceanography of the Western Atlantic, north of Trinidad, in this way supplementing the work of the International Council for Exploration of the Sea. It also assumed as a fundamental objective the establishment of cooperation between all the American agencies concerned in ocean sciences, whether connected with state or private institution or with federal establishments such as the Navy, especially its Hydrographic Office, the Bureau of Fisheries, the U. S. Coast Guard and the Coast and Geodetic Survey. A small, capably selected staff was established, and the facilities of the station were created on a generous scale and

made available for the use of the universities and the government agencies concerned.

I think it is fair to say that, while the establishment of the Woods Hole Oceanographic Institution is in many respects the most conspicuous aspect of its work, the committee did not forget the broad assignment "to consider the share of the United States of America in a world-wide program of oceanographic research," and has supported the development of existing oceanographic stations on the Pacific coast and of the Bermuda Biological Station for Research on an international basis.

The responsibility for the continuation of the program assigned by the academy to its committee on oceanography has been transferred to the agencies thus set up, and the committee was accordingly discharged at its request in 1938.

FRANK RATTRAY LILLIE

PRESENTATION OF THE PUBLIC WELFARE MEDAL TO JOHN EDGAR HOOVER

BY temperament, by tradition and by resolution, the people of the United States are devoted to the ideal of human freedom and human dignity. This ideal may be threatened from without our country or from within, and the dictum that eternal vigilance is the price of liberty applies as well in the one case as in the other. The great science of medicine has been developed to preserve the physical and mental health of the individual. Of equal importance is the safeguarding of the health of our social organism. There exist constantly in this organism malignant cells, often combined into groups, enemies of the wholesome life.

To maintain law and order in our society is more than to preserve property or safeguard life. It is to maintain a social framework in which the good life may be lived to free men from the threat of vicious cruelty of the criminally minded. Respect for government itself grows as governmental agencies succeed in this vital work of the preservation of freedom.

To-night the National Academy of Sciences presents the Marcellus Hartley Medal for great public service to the director of the Federal Bureau of Investigation of the United States Department of Justice. John Edgar Hoover was born and educated in the District of Columbia. At the completion of his legal training he entered the Department of Justice in 1917, and in 1919 was appointed a special assistant to the Attorney General. In 1921 he became assistant director of the Bureau of Investigation and in 1924 was named its director.

Hoover brought to this great agency of American law enforcement a high idealism, great organizing ability and a trained mind. He insisted at once on freedom in making appointments to his staff from any political pressure, and rapidly raised to a high level the requirements in character and training for the personnel of the bureau. Brain and character—not brawn—became the word. College graduates—not political cast-offs—became his special agents. Specialized functions were organized and raised to a high efficiency. Their names are familiar to all: the Identification Bureau, the Crime Laboratory, the Department of Crime Statistics. Through the National Police Academy with an outstanding group of instructors, police officers from the entire country share the intensive training of the agents of the Federal Bureau. Through this organization the dignity and ability of a profession are being brought to a level consistent with its social importance.

The potential value of the work of Hoover is great, but its worth has already proved itself with startling and dramatic force in present performance. Since the Federal Bureau was given authority to investigate bank robberies there has been a reduction in this crime of 75 per cent. The percentage of convictions secured in cases investigated by the Bureau is 96. In the most recent fiscal year 5,162 convictions were secured. During the past five years for every dollar expended in the operation of the Bureau $6.33 has been returned to the government in recoveries and savings. In 1932, when Congress passed the Federal Kidnapping Statute, this vicious crime was a national menace, a challenge to the decency of American life. Since that time the Bureau has investigated 178 kidnapping cases. All but two have been solved. In 1939, 20 kidnapping cases were reported to the Bureau. All were solved.

The Federal Bureau has rendered these great services to the American people. Its activities are a part of the great non-political functions of government. As Hoover has kept its personnel and its activity free from political influence, so do we expect that its services for good government will proceed unharrassed by political interference.

In spirit and performance the work of John Edgar Hoover has exemplified the scientific way of life. To the many formal expressions of appreciation which he has received we add to-night that of the National Academy of Sciences for great public service performed in a scientific manner and by the aid of science.

MAX MASON

RESPONSE BY THE MEDALIST

IN accepting the Public Welfare Medal of the National Academy of Sciences, I first want to acknowledge the contributions which this academy has made to the furtherance of science in America. Secondly, I accept this medal, not for myself alone, but also as a tribute to my associates—the patriotic men and women

of the Federal Bureau of Investigation whose personal sacrifices have made possibe its achievements.

The history of the development of science throughout the world reflects a long combat with scorn, ridicule, sacrifice and even torture. Despite temporary setbacks from these sources, the march of science never has been permanently impeded. All obstacles and barriers have been hurdled because truth has triumphed. The development of science in the field of crime detection has not been without its annoying interruptions. With the inauguration of the Technical Laboratory of the FBI in 1932 came ridicule and scorn. On more than one occasion our men have been ironically depicted as impractical young men pursuing criminals while clad in academic gowns carrying magnifying glasses.

Old-line police officers of another school were ever ready to scoff at the special agents who photographed crime scenes, processed everything for fingerprints, and then sought the assistance of the white-garbed scientist often hundreds of miles away to analyze and identify some tell-tale bit of evidence left behind by a fleeing criminal. They denounced the new method of seeking facts rather than the old one of seeking men with the hope that if enough were rounded up the guilty one might be found. Even unenlightened judges claimed the right to ridicule the science of the test-tube, the microscope, the spectrograph and other precise methods of identifying bits of evidence that pointed an unflinching finger at the guilt of the wrong-doer and cleared the innocent suspect. This was circumstantial evidence, they claimed, and was at its best open to doubt.

Then with the development of scientific crime detection came the fakir and the pseudo-scientist whose testimony was determined by the side that retained him and the size of the fee that was paid him. To-day, fortunate for the cause of justice, the pseudo-criminologist is justly held in disrepute. The once ready ridicule and scorn for the investigator who utilized the scientific aids available in crime detection have changed to praise.

The evidence from laboratory analyses to-day is regarded as far more unbiased and certain than eye-witness testimony. Certainly, it is safer because the photo-micrograph made by the honest expert of physical bits of evidence, revealing to the eyes of jurors the basis for expert conclusion, does not and can not falsify, neither is it affected by the vagaries of the human senses.

If the record of the Federal Bureau of Investigation means anything, it has proven that science is the greatest weapon next to intelligent, well-trained personnel that society possesses to cope with the criminal. No longer do courts question the validity of the qualified scientific expert.

The experiences of the past few years have demonstrated conclusively that science protects the innocent and convicts the guilty. Surely a record of over 95 per cent. convictions in all cases tried in court after investigation by special agents of the FBI is a tribute to the place of science in the world of law enforcement. There can be no question that we have been justified in investing the taxpayers' money in the equipping and maintenance of a Scientific Crime Detection Laboratory that is regarded as a model throughout the world, when over a period of years every dollar spent in the cost of operations of the FBI has resulted in a dividend of over six dollars for the taxpayers of America.

Thus it is with pardonable pride that I accept the Public Welfare Medal of the National Academy of Sciences for and in behalf of the entire personnel of the organization that I have been proud to head for the past sixteen years; for ours is truly a "We" organization and not an "I" organization, and no finer recognition could be bestowed upon the FBI for its part in furthering science in the detection of crime than this award. May we regard the past as a period of introduction of science into the profession of law enforcement which will blossom and bear fruit in the years to come in every community in America, in order that justice may ever remain triumphant.

JOHN EDGAR HOOVER

PRESENTATION OF THE CHARLES DOOLITTLE WALCOTT MEDAL AND HONORARIUM TO A. H. WESTERGAARD

THE Walcott Medal was founded by Mrs. Mary Vaux Walcott in honor of her husband, a former president of this academy, Dr. Charles Doolittle Walcott. Dr. Walcott was an exceedingly active and influential figure in the scientific development of the United States. For many years chief of the U. S. Geological Survey, he was also a pioneer in promoting conservation, especially in forestry. He took a leading part in organizing the Carnegie Institution, the National Research Council, the National Advisory Committee for Aeronautics and in the expansion of the National Academy of Sciences. For twenty years he was secretary of the Smithsonian Institution.

But Dr. Walcott's first love, and the subject which he indefatigably pursued throughout his career, was the discovery and investigation of the earliest forms of life. Measured by present radioactive means, the Cambrian period, wherein were laid down the earliest fossil forms yet known, dates from several hundred million years ago. Yet at that remote period creatures of great complexity and beauty of structure had already evolved. Knowing so intimately Dr. Walcott's great love for the study of the Cambrian

and Pre-Cambrian deposits, Mrs. Walcott has established the medal for especially meritorious research in this field. The committee in charge of its award comprises the secretary of the Smithsonian Institution, *ex officio,* two eminent geologists of this academy, a representative of the Institut de France and a representative of the Royal Society of London.

The committee has unanimously recommended the award this year to Dr. A. H. Westergaard, of the Swedish Geological Society of Stockholm, for his eminent researches on the stratigraphy and paleontology of the Cambrian formations of Sweden.

Westergaard's major work, published in 1922, "is a complete description of the trilobite species of which about 28 were new. The beds of Norway and Denmark are correlated with the Swedish formations." Now a man of 60 years, Westergaard is still active in the Cambrian field, having published frequently and regularly right up to the present time. His latest publication, in 1938, describes a deep boring through the Cambro-Silurian at File Haidar, in Gotland, and contains accounts of Lower and Middle Cambrian deposits therein and of the contained faunas.

In view of Dr. Westergaard's valuable contributions to both stratigraphy and paleontology of the Cambrian period, and his continued zeal in these investigations, the committee of award has much pleasure in recommending that the Charles Doolittle Walcott Medal and Award be presented to him.

C. G. ABBOT

The medal was received for Dr. Westergaard by the Minister of Sweden, the Honorable W. Bostrom, for transmission to him through diplomatic channels.

ABSTRACTS OF PAPERS

The probability concept: EDWIN C. KEMBLE. The long-standing controversy over the nature of probability may be resolved by the type of operational analysis so fruitful in physics. Probability is related to our subjective sense of expectancy in much the same way that a thermometer reading is related to our subjective sense of heat and cold. Probability can be defined as a number derived by standardized mental operations from a definite state of information. In so far as it is dependent on information it is subjective. In so far as the evaluation of probabilities from given data is standardized in a manner acceptable to many persons the concept becomes objective. There is no *a priori* necessity for a *single* rule for evaluating probabilities from all states of information, and one must admit that where the information is vague *no* calculation of an acceptable probability is possible. Evaluation of probabilities on the basis of a principle of indifference is appropriate to one type of informational situation, whereas calculation from relative frequencies in a collective is appropriate to another. There is use for both types of probability in practical and scientific matters. Either one can be used with the standard calculus of secondary probabilities from primary probabilities. However, there is a sharp distinction between the totality of implications which can be drawn from the two corresponding states of information. Failure to observe this distinction is a common and serious error in probability calculations.

Recent experiments on cosmic rays at high altitudes: WILLIAM P. JESSE (introduced by A. H. Compton). During the past year the cosmic ray investigators at the University of Chicago have carried out three different experiments to investigate some of the interesting phenomena associated with cosmic rays at altitudes of twenty thousand feet and higher. Marcel Schein and E. O. Wollan in collaboration with the writer have been able by coincidence counter apparatus carried by balloons to determine as a function of altitude (1) the vertical intensity of the mesotrons in the atmosphere and (2) the number of mesotrons generated in a block of lead 2 cm thick by non-ionizing radiation. The mesotron intensity was found to increase rapidly with altitude up to a maximum value at about 6.6 cm pressure and then to decrease. The production of mesotrons in the lead block becomes noticeable at an altitude of 5 km and from this point on increases with altitude at about the same rate as does the soft component of cosmic rays. In a second high altitude experiment by G. Herzog a counter-controlled cloud chamber and magnet were carried in an airplane to a height of 29,000 feet to obtain photographs of slow mesotron tracks. Mesotrons can be distinguished from electrons in a cloud chamber by reason of the increased ionization along the tracks only when the momentum of the mesotron lies within a range of relatively low values. Mesotrons of such low momentum values occur so rarely at sea level that from thousands of cloud chamber photographs made at the surface of the earth not more than a dozen tracks have been clearly distinguished as mesotron tracks, and mass estimates made. Above twenty thousand feet such slow mesotrons were found by Herzog in much greater abundance. From 230 photographs obtained, more than twelve tracks could be definitely identified with the passage of a mesotron. A third experiment by the writer has consisted of a series of thirteen balloon flights in which an ionization chamber was carried up to an altitude of approximately 25 km in an attempt to determine a possible time variation in the total intensity of cosmic rays near the top of the atmosphere. Time changes of more than fifteen per cent. have been observed during the past year. Such changes follow quite closely the "world-wide" variations of Forbush and others and are probably due, in part at least, to intensity changes in the magnetic field surrounding the earth. However, when the high altitude values are corrected on the basis of ground values for the "world-wide" variations, a residual effect remains with a maximum in the early spring and minimum in the late summer. Further experiments are necessary to determine whether this is a true seasonal effect.

Toxicity of alpha and fast neutron radiation: ROBLEY D. EVANS (introduced by John C. Slater). Results of experiments on neutron tolerance in animals can not be accurately extrapolated to man because the relative radia-

ion sensitivities are entirely unknown for small doses. Biological effects of neutrons are due to the secondary recoil rays which they produce in the body by collision with hydrogen, carbon, nitrogen, oxygen and other atoms. The average specific ionization, and hence the ionic effectiveness, of the neutron recoil rays is closer to that of alpha rays than to any other radiation which has been the subject of extensive biological investigations. Data are available from studies of chronic radium poisoning and of lung cancer produced by radon inhalation, concerning the effects of alpha rays on human tissue. Using these data, it is shown that a dosage of 0.01 n per day of fast neutrons may be unsafe if the exposure continues over a period of about ten years.

Remarks on the theory of nuclear resonances: G. BREIT. Pronounced resonances are observed in a number of nuclear reactions and it is customary to interpret these as due to the formation of temporarily stable states of the compound nucleus. While this qualitative picture is applicable in many cases its quantitative validity is doubtful. Some limitations of the "dispersion" treatment which become apparent when the wave equation is treated accurately are as follows: (a) Coupling through the field changes the position of the levels in addition to the Dirac frequency shift. (b) The same energy level should not show peaks at the same energy in different reactions. Shifts of the order of the level width are expected. Sufficient conditions for the absence of shifts are known. (c) The combined effect of several levels shows itself in interference in both the numerator and denominator of a fraction. (d) Neither the regular nor the irregular (F, G) solutions of the radial wave equation are universally applicable to the computation of mean lives of compound states. Green's function for two and more dimensional separable problems is used for an estimate of competitive effects of nuclear excitation. Additional justification is given to the form of dispersion theory worked out by Wigner and the writer.

The magnetic properties of the transition elements: F. BITTER (introduced by Karl T. Compton). The main objective of the present cryomagnetic research at M. I. T. is to provide information about electronic configurations and interaction energies in solids. Our first experiments have been on compounds and alloys of the transition elements Cr, Mn, Fe, Co, Ni, Cu. We plan to complete a general survey of these substances from 14° to 1,200° Abs. in large and small fields. By way of illustration, the properties of iron will be discussed. α-iron, Fe_3O_4, one form of Fe_2O_3, FeS are ferromagnetic. γ-iron and hematite (Fe_2O_3) are not. Our own results on $FeCl_2$, $FeCl_3$ and on alloys of copper containing less than 1 per cent. of Fe in solution show strong paramagnetism with interesting anomalies at low temperatures. Also an alloy of gold containing 12 per cent. of iron in solution, although it has a face-centered cubic structure like γ-iron, is ferromagnetic up to 230° C. (*Bulletin Am. Phys. Soc.*, 15: 20, 1940). The theory of solids is sufficiently advanced to attempt at least a qualitative description of the above facts. Such an attempt will be outlined, starting with assumptions about the Fermi energy resulting from the application of the exclusion principle and about the Heissenberg exchange energy, and then calculating the properties of iron atoms in various geometrical configurations.

Zeeman effects and preliminary analysis of singly-ionized praseodymium (Pr II): GEORGE R. HARRISON and NATHAN ROSEN (introduced by Karl T. Compton). The magnetic resolution of spectrum lines emitted by the singly ionized praseodymium atom has been studied at fields up to 95,000 gauss, using a 1,700-kilowatt Bitter electromagnet. Three concave gratings of 10-meter radius were used simultaneously to photograph the spectrum between 2,200 and 8,000 A, giving dispersions of 0.8 A/mm for the ultra-violet range and 1.6 A/mm for the visible and near infra-red. The wide hyperfine structure and complicated overlapping of many of the Zeeman patterns renders their separation difficult, but several hundred patterns have been reduced to obtain information about spectral terms. Many intense lines are found to be multiplet second-order satellites, indicating wide departures from LS coupling, as is to be expected. An unusual number of terms having the same g-values are found, possibly indicating a degradation of many terms to a common value through strong mutual perturbations between them. Since the spectrum is rich in lines and of intermediate coupling, no single method of analysis is found sufficient, and it is only by the combined use of improved wavelength measurements, hyperfine structure analysis, Zeeman effect analysis and excitation studies that the many possible quadratic arrays, which applications of the combination principle through the interval sorter and recorder have brought to light, can be critically compared. By using all these methods a rapidly growing array involving several hundred lines has been set up.

An apparently fundamental minimum lethal ion equivalent: ALEXANDER GOETZ (introduced by Robert A. Millikan). It is well known that living cells are affected by extremely small concentrations of ions of heavy metals, so small that they may be beyond the limit of microchemical detection. It is generally estimated that a living cell is killed by $10^5 - 10^8$ ions, depending on the biological state of the cell and the nature and conditions of the environment. Extended investigation of the exact magnitude of the lethal cell-metal ion equivalent (ν) have been made for the case of silver ions and yeast cells (Sacch. cerevisiae) in order to find the conditions for which the value of ν is a minimum. A differential staining technique indicative of the affection of a cell by Ag ions was developed, permitting thus the accumulation of considerable statistical material by microscopic count. It was found that ν decreases with the concentration of protecting colloidal material present and the avoidance of ion absorption on the walls by proper mixing methods. The techniques finally developed bring the value of ν down to numbers so small that the Poisson relation $\frac{(n/N)^\nu}{\nu!} \cdot e^{-n/N}$ (n and $N \sim$ number of ions and cells respectively per unit volume) could be applied for solutions of silver of 10^{-6} γ/liter ($1\ \gamma = 10^{-6}$ gr) obtained by a special diluting tech-

nique and cell concentrations of the order of $10^6 - 10^7$ per cc. The result of a large number of counts shows a considerable probability for the fact that if the conditions for "ideal" statistical mixing are well approximated by the experiment $\nu = 1$, *i.e., one ion only is capable of producing an irreversible change of the cell.* This is indicated by the absence of a maximum in the function $\triangle (N)_{\nu=1}$ ($\triangle \sim$ number of dead cells) for a variation of N between 0 and 10n. This finding implies that in a sense the living yeast cell acts towards a metal ion as *one* large molecule. The effect of the ion on the cells takes less time than the manipulation, and the changes produced appear not to impair the capacity of the cell to absorb almost any additional quantity of ions, which fact gives cause to a "shielding" effect among the cells for cell concentrations above 5×10^7 cells/cc.

A new conduction of heat phenomenon: G. W. STEWART. It is currently accepted that the transfer of energy in the conduction of heat in solids and liquids occurs by means of acoustic waves. In solids these consist of longitudinal elastic waves. In liquids it has recently been argued by Lucas that the more important carriers are transverse waves of viscosity and inertia. A new phenomenon in heat conduction has been found which is most easily interpreted by the presence of these transverse waves of viscosity and inertia. If the molecular swarms in liquid crystalline para-azoxyanisol are studied by means of x-ray diffraction, facts may be obtained concerning the orientation of these elongated swarms under the application of either the magnetic field or heat conduction. It is demonstrated that the swarms are oriented by the conduction of heat, their long axes perpendicular to the direction of the conduction. This phenomenon has been established by two experimenters, Holland and Reynolds, with different apparatus and methods. The orientation of the swarms corresponds to the effect of a cross-convection current. The transverse waves of Lucas may produce this result. These experiments demonstrate a new phenomenon and also add credence to the importance of the transverse waves of viscosity and inertia.

Absorption spectra of gases in the extreme ultra-violet: T. TAKAMINE and Y. TANAKA (introduced by Walter S. Adams). With the aid of a vacuum spectrograph provided with a concave grating of 20 cm radius, which was used at grazing incidence, the resonance series of H, He, Ne and A, lying in the region of extreme ultra-violet, were investigated. Lyman continuum from a quartz capillary discharge was as a rule used as the background. Excepting the case of hydrogen, the spectrograph was filled with different gases whose pressure could be varied. In He, beside the fact that several members of the 1'S–m'P series were obtained as absorption lines, the following features were noted: (1) The continuous emission spectrum of helium which shows two distinct maxima near λλ800A, 650A, produced by a condensed discharge is not absorbed even when the pressure of helium in the spectrograph is fairly high. This fact is significant because it shows that the helium continuum is of molecular origin, as has been generally accepted. (2) With increasing pressure of helium, the absorption line λ584A showed an unsymmetrical broadening toward shorter wave-length, coinciding exactly with Hopfield's[1] observation in the case of emission. For neon, the line λ736A was seen as an absorption line, and for argon the observations of Beutler[2] were confirmed. Here again, with increasing pressure, quite an unsymmetrical broadening of the line λ1048A was noticed just as shown by Beutler for corresponding lines of krypton and xenon. In the case of hydrogen, dry hydrogen at about 1 mm pressure was kept flowing through the quartz capillary discharge above mentioned. Several earlier members of the Lyman series were obtained in absorption. This part of our work is still in progress.

Infrared transmission of the human body: C. HAWLEY CARTWRIGHT, JOHN DANIEL and ALEX PETRAUSKAS (introduced by Karl T. Compton). The percentage reflection and transmission of a human cheek was measured as a function of wave-length in the visible and infrared spectra. Absolute values were obtained to 12,000A by using a special photocell and an integrating sphere, for collecting all the light. The reflection of the cheek reaches a maximum of about 50 per cent. in the visible red and gradually decreases for longer wave-lengths. The cheek (10 mm thick) is opaque below 6,050A and increases its transmission linearly to about 2 per cent. of that entering the skin at 7,000A. Between 7,000A and the water absorption band at 10,000A, the transmission is rather uniform. Beyond 10,000A, the transmission rises, reaches a maximum value of about 3 per cent. at 11,000A and decreases to zero beyond 13,500A, due to the water absorption. Using as a control a bearable discomfort on the outside of the cheek, measurements of the temperature rise inside the mouth were made using various sources of radiation. The best of these was a tungsten lamp with a water filter. An increase in temperature of 3° F. was obtained inside the cheek without external discomfort.

Introduction of liquids into tissues by means of a high velocity jet: G. FAILLA and T. R. FOLSOM (introduced by Harold C. Urey). Injuries have resulted from oil found at considerable tissue depths in workers with high pressure oil. The oil, emerging in a fine stream from a tiny hole, penetrated the tissues without the person being aware of it. This and tests made elsewhere, suggested the possibility of similarly introducing liquids into tumors (*e.g.*, distilled water to enhance the effect of x-rays or radioactive isotopes in solution or suspension). Preliminary tests with pressures under 15,000 pounds per square inch and a diamond orifice 0.002 inch in diameter, show the penetration of water jets through the skin to depths of two or more centimeters, depending on the structure of the underlying tissue. Skin itself offers considerable resistance. The water jet is capable of traversing seven or more centimeters of raw potato. The serious objection of the large amount of air carried into the tissue by the jet is overcome readily by exhausting the air from the applicator held in contact with the tissue. A distinct superiority of the jet over the needle method of introducing liquid into tissues is not apparent so far.

[1] J. J. Hopfield, *Ap. J.*, 72: 133, 1930.
[2] H. Beutler, *Zs. f. Phys.*, 92: 177, 1934.

Anthropological relations between Siberia and America: ALEŠ HRDLIČKA. In 1939, due to the courtesy of the Soviet Government and the wholehearted assistance of the Russian men of science together with the Russian Organization for Cultural Relations, the speaker was able to examine the important anthropological and archeological collections in Leningrad, Moscow and Irkutsk; and to participate briefly in some excellent field work carried on by Russian scholars along the Angara River in the Irkutsk region, now known to have been a center of a large neolithic population. This population, as it becomes better known, is proving of the utmost interest to students of prehistoric Siberian-American connections. The anthropological and cultural collections of Leningrad and Moscow have fortunately, during the World War and the troubled times thereafter, escaped serious damage, and are now gradually being brought again into order. They contain precious and now largely unique materials from the Russian territories in America, particularly from the Aleutian Islands, and they include many and in some cases large series of skulls of the native peoples of Siberia, which are essential for the studies on Siberian-American relations. All this material was placed freely at the speaker's disposal. It showed group after group of closely related forms to American remains, both Indian and Eskimo. The chief evidence, however, was presented by the neolithic skulls and skeletons of the Angara region. These remains by various features connect still with paleolithic man; aside from this all their important characters are American-like. The resemblance is with the Shoshonean-Algonkin and Piman-Aztec American type. The Angara skulls and bones, if mixed with the skulls and bones of these Indians, could not be told apart. This neolithic population lived in the Irkutsk regions to about 3,000 years ago—perhaps even later—then vanished. But along the northern Yenisei, of which the Angara is a tributary, there are to this day among the natives many individuals whose features resemble the American Indian.

A synthesis of radioactive lactic acid: G. B. KISTIAKOWSKY and RICHARD CRAMER. Radioactive lactic acid containing the C^{11} isotope in the carboxylic position was synthesized from carbon oxides produced by the bombardment of boron oxide by deuterons in the Harvard cyclotron. The oxides were converted to carbon dioxide and were reacted with ammonia and potassium to give KCN in good yield. Potassium cyanide combined with acetaldehyde in alkaline solution to give a α-hydroxyl-propionitrile which was hydrolyzed by hydrochloric acid to lactic acid. The mixture was made alkaline again, evaporated to dryness and extracted with acidic dry ether to eliminate inorganic materials. The ether phase was then extracted with water to separate lactic acid from polymerized acetaldehyde and concentrated to about 2 cc volume containing some 50 mgr of lactic acid, to which 100 mgr of ordinary d-l lactic acid were added when needed. The entire synthesis took approximately 1½ hours, the yield on C^{11}, allowing for radioactive decay, being about 30 per cent. The residual radioactivity was sufficiently strong to follow it for approximately five hours and thus the biological experiments described in the following abstract could be performed.

Liver glycogen from lactic acid containing radioactive carboxyl carbon: A. B. HASTINGS, G. B. KISTIAKOWSKY, R. D. CRAMER, F. W. KLEMPERER, A. K. SOLOMON and B. VENNESLAND. The fate of lactic acid, containing radioactive carbon in the carboxyl group ($CH_3 \cdot CHOH \cdot C^{11}OOH$), has been studied in rats. The immediate purpose of the experiments has been to determine whether the increase of liver glycogen is or is not accompanied by radioactivity, proportional to the amount of lactate converted to glycogen. When rats were fed 150 mg of radioactive d-l lactate, the total liver glycogen increased, on the average, 50 mg within a two and one half hour period. This corresponds to 33 per cent. of the administered lactate. The radioactivity of the glycogen was only from < 1 to 3.6 per cent. of the administered radioactive material. During the same time, the expired CO_2 contained more than 10 per cent. of the radioactive carbon administered as lactate. These results suggest either (1) that the lactate molecule may undergo a stage of decarboxylation before conversion to glycogen (*cf.* Conant and Tonberg, *Jour. Biol. Chem.*, 88: 701, 1930), or (2) that the increase in liver glycogen may have arisen in these experiments from some precursor other than the radioactive lactate. The possibility that a small amount of glycogen may be synthesized directly from lactate without decarboxylation is not entirely excluded.

Antihemorrhagic compounds: E. A. DOISY, S. B. BINKLEY, S. A. THAYER, R. W. MCKEE and D. RICHERT. Subsequent to our isolation of the natural antihemorrhagic compound, vitamin K_1, our investigations were extended in several directions. The structure of vitamin K_1 was deduced from the results of degradation experiments and the deduction confirmed by synthesis. Study of the structure of the other natural antihemorrhagic compound, vitamin K_2, has shown that, similar to vitamin K_1, it contains a 2-methyl-1,4-naphthoquinone structure but differs from the latter in the nature of the substituent in the 3-position. The substituent in vitamin K_2 is a hydrocarbon radical of thirty carbon atoms. Since the natural vitamin K compounds are not soluble in water and superior therapy could be attained in many cases by parenteral administration, several different water-soluble antihemorrhagic compounds have been prepared. They have been administered intravenously to chicks showing severe symptoms of vitamin K deficiency and their activities determined by the capacity to restore the prothrombin time to normal.

The difference between men and women in their response to heat and cold: EUGENE F. DUBOIS and JAMES D. HARDY. This study is a natural sequence to the researches recently carried out in our laboratory on the reaction of men to environmental temperature. Previous work has been restricted to a study of men, and as there is some evidence of differences in the reactions of men and women to heat and cold the study could be considered only half done. Six women subjects between the ages of twenty-two and thirty-five were studied in the human calorimeter of the Russell Sage Institute. The subjects were in a basal condition and nude. From the calorimeter itself, thermal heat loss, heat loss from vaporization and heat production were obtained. Measurement of the skin tem-

perature was done radiometrically by the subjects. The absolute humidity for all experiments was low and varied little from time to time. The reaction could be related to a single variable, the calorimeter temperature, which was varied from 22 to 35° C. in different experiments. The observations were: (1) The rectal temperature decreased 0.15° from the warm to the cold environments and was essentially the same as that for the men. (2) The average skin temperature in the cold environments was colder by 1.0° C. than that for the men, and in the warm environments was 2.0° C. higher than that for the men. (3) The heat loss for the women was less by about 5 cals/m²/hr than that for the men and decreased in the neutral environments to an average of 28 cals/m²/hr. The lowest value of heat loss for the men was 36 cals/m²/hr. (4) The conductance of the peripheral tissues for the women was less than that for the men by the equivalent of 4 mm of fat tissue. (5) Both sexes obeyed physical laws of cooling and lost 5.3 cals/m²/hr/°C. (6) Vaporization in women was the same as that in men at temperatures lower than 28° C. For temperatures higher than 28° C. the vaporization loss in the women was much smaller than that of the men. (7) Metabolic rate for men was constant throughout the experimental range at 35 cals/m²/hr. The metabolic rate for the women at temperatures lower than 28° C. was the same as that for the men. Warmer than 28° C., the metabolism of the women decreased with temperature to an average of 29 cals/m²/hr. This is the first evidence that we have been able to find of the chemical adjustment to temperature, and this response appears to be a response to heat and not to cold.

Studies in pain sensitivity: GEORGE A. SCHUMACHER, HAROLD G. WOLFF and HELEN GOODELL (introduced by Eugene F. DuBois). Quantitative measurements of the pain threshold were made by exposing 2.5 cm² of skin surface on the forehead for three seconds to thermal radiation. The intensity of radiation which barely evoked pain was denoted as the pain threshold. By this means the normal pain threshold level was established to ±2 per cent. On over 100 subjects of both sexes, of different ages, education and social experience, the pain threshold was ascertained by this method. Each subject was asked to express an opinion about his own pain sensitivity. With few exceptions there was no relation between the personal estimation of hypersensitivity or hyposensitivity and the pain threshold as here measured. The series of pain threshold determinations when plotted produced a bell-shaped curve with ±16 per cent. as the limit of deviation from the mean, and with 91 per cent. of all the determinations falling within ±8 per cent. deviation from the mean. From these data it is inferred that the pain threshold in man, as with temperature, pulse and respiration, is relatively stable. In contrast to this uniformity in the threshold for the perception of pain are the wide individual variations which occur in the reaction to pain. This latter seems to be dependent upon individual experience and attitude.

Bombarding atoms (illustrated): ERNEST O. LAWRENCE.

The control of respiration under artificial respiration: YANDELL HENDERSON. Normal respiration is mainly controlled by the carbon dioxide produced in the body. The respiratory center in the brain regulates the breathing so that the volume of air with which the lungs are ventilated is almost exactly twenty times the volume of carbon dioxide that the blood brings from the tissues of the body to the lungs. A man walking slowly produces twice as much carbon dioxide as when sitting still, and he breathes twice as much air. When he does enough work to produce three times as much carbon dioxide as at rest, he breathes three times as much air. But suppose that a man, instead of breathing for himself, is subjected to artificial respiration, as if he were being resuscitated from drowning. Or suppose that he has been submerged in water until he is unconscious, and has stopped breathing; and that a policeman or a boy scout is administering artificial respiration. How much air will enter his lungs? And will the operator or the victim's own respiratory center regulate the amount? The answer is important; for, if the operator controls, it is possible that by pulling or pushing or poking the victim in some particular way, more air can be got into the lungs than by the standard Schafer, or prone pressure, method of artificial respiration. A number of methods have been devised that claim to be better than that method. But in fact, as the evidence to be presented to the Academy shows, the respiratory center, even when a man is unconscious and breathless, still controls the tonus and elasticity of the muscles of the chest; and this tonus determines how much ventilation can be produced. The conclusion, which is both of theoretical interest and practical importance, is that the method now used is the best, or is as good as the best, that can ever be invented. In order to promote a decision on this matter, I have placed 100 Swiss francs in the hands of the International Congress of Life Saving and First Aid (headquarters in Zurich) to be awarded as a prize to any one who can devise a manual method that, after application for 15 minutes on a normal man, will induce an apnea vera of 3 minutes. As I believe that no such method can be devised, I have also authorized the congress, after five years, to use the prize for any other suitable purpose.

A new group of filterable saprophytes: L. O. KUNKEL. A group of filter-passing organisms commonly found in juices from tobacco and tomato plants affected by tobacco mosaic or certain other virus diseases and occasionally found in juices from healthy plants of these species has been isolated and cultivated in cell-free media. Several members of the group have been passed in series in sterile juice from healthy tobacco plants. One isolant is now in the twelfth passage. The organisms produce characteristic translucent colonies that are birefringent and resemble spheroid crystals. They are composed typically of radiating needle-shaped or plate-shaped structures that may be dissolved in dilute solutions of sodium or potassium hydroxide. When films from solutions in which colonies have dissolved are dried and treated with Morosow's stain, large numbers of minute spherical particles become visible when viewed under a microscope. The particles occur singly or in chains of twos, threes, and fours. The chains suggest that multiplication is by division and that the particles are minute cells. All members of the group readily pass

Berkefeld filters of grade W, and some pass collodion filters having pores of such fineness that they hold back the virus of ordinary tobacco mosaic. The chief interest attaching to the organisms, whose taxonomic affinities are still undetermined, arises from their ability to pass filters and to build crystal-like colonies.

The division of mature plant cells induced by wounding: EDMUND W. SINNOTT and ROBERT BLOCH. In the development of wound cork stimulated in plant tissues by surface injury, cells which are large, vacuolate and mature may be induced to divide. Division here occurs in a plane parallel to the wound surface. An early step in the process is for the nucleus to become spherical and to move toward the center of the vacuole, where it is suspended by strands of cytoplasm. In this position it undergoes mitosis. A characteristic feature of the division of such cells and one which has not been generally recognized is the tendency for the cytoplasm to become aggregated very early in the position where the future cell wall will be developed. The location of this cytoplasmic plate, for which the authors propose the term *phragmosome*, thus indicates the plane of cell division considerably before the nucleus has done so. This feature of cell division is also characteristic of normal meristematic tissues where the dividing cells are markedly vacuolate.

Growth changes resulting from chromosome rearrangement: D. F. JONES. With the discovery of material that is particularly favorable for the study of changes during development it has been possible to make a new approach to the problem of abnormal growth. The endosperm of the maize seed has genetic characters that can be used as markers to detect nuclear alterations that are ordinarily never seen in somatic tissues by direct cytological examination. By the use of these chromosome markers it has been shown that there are many changes in the nucleus that have their effect in the cytoplasm. These changes are relocations of chromosome parts removing marker genes from some cells and replicating them in others. These relocations are not visible in the animals usually used for tumor investigations but are easily seen when the altered chromosomes are paired with their normal homologs in synapsis at the formation of reproductive cells in favorable plant material or in the salivary glands of flies. The new evidence derived from paired mosaic areas in the endosperm of maize and other food storage tissues shows that chromatin rearrangements may result in permanent alterations in growth activity as well as in color, size, shape and composition of cells. Thus the same process that is involved in the formation of new species of living organisms also produces new kinds of cells in somatic tissues and these new cells may become independent of normal control. Up to the present time it has been considered generally that chromosomal alterations are the result and not the cause of abnormal growth. This is true for the gross chromosomal aberrations visible in somatic cells but these have obscured the significant alterations that are responsible for the changes from normal at the start. It is now apparent why external agents such as physical radiations, carcinogenic chemicals, hormones, viruses, parasitic organisms and what next, can produce the same result as inherited tendencies, either by increasing the frequency of chromosome breaks and relocations or by altering the growth-regulating regions in the chromosomes.

Utilization of induced periclinal chimeras in determining the constitution of organs and their origin from the three germ layers in Datura: ALBERT F. BLAKESLEE, SOPHIA SATINA and AMOS G. AVERY. Study has been made of 69 periclinal chimeras in *Datura stramonium* which had been induced by colchicine treatment. In these chimeras it is possible to label individual germ layers and the tissues derived from them by means of differences in chromosome number and resultant differences in size of cells and their nuclei. The evidence points to the presence of three germ layers in Datura. Nine different types of periclinal chimeras were identified in which one or more of the three germ layers had an altered number of chromosomes ($4n$ or $8n$ in contrast to the normal $2n$ condition). The most frequent type (42 cases) had a doubled number of chromosomes in the dermatogen or outermost layer; the next frequent type (29 cases) had a doubled number of chromosomes in the plerome or innermost layer; the least frequent type (19 cases) had an altered number of chromosomes in the periblem or middle layer. The three germ layers differ in the contributions which they make to the primordia of different organs. Thus the interior of developing leaves, sepals and petals is made up chiefly from the middle germ layer or periblem but the interior of the developing stamen and pistil consists chiefly of the innermost layer of plerome. This difference suggests that sepals and petals are homologous but that stamens and pistils may have a different phylogenetic origin. From the morphological appearance of the different kinds of periclinal chimeras, it is evident that each of the three germ layers has a recognizable effect upon the size and shape of the various organs of the plant. Increase of chromosome number in either of the two inner layers (periblem and plerome) appears to have a more marked influence upon the external morphology than does increase of chromosome number in the outer layer (dermatogen).

(*To be continued*)

OBITUARY

DAVID M. MOTTIER

DR. DAVID M. MOTTIER, professor emeritus and former head of the botany department at Indiana University, died on March 25 at the home of his daughter, Mrs. Lyman R. Pearson, of Indianapolis.

Dr. Mottier was born near Patriot, Switzerland Co., Indiana, September 4, 1864, the son of David and Lydia Mottier. He attended Indiana University, receiving the A.B. degree in 1891 and the A.M. degree in 1892. Here he was a student of David Starr Jor-

dan, John Merle Coulter and D. H. Campbell. His graduate work was completed under Strasburger at the University of Bonn, from which institution he received the Ph.D. degree in 1897. During the following year he carried on research work at the University of Leipzig and the Biological Station at Naples. He became instructor in the botany department of Indiana University in 1891, was advanced to an associate professorship in 1893, and became full professor and head of the department in 1898. Dr. Mottier occupied this post with distinction until 1937, when he became professor emeritus.

Dr. Mottier brought to his work, both as teacher and investigator, a keen mind, a highly developed critical faculty and an unusual breadth and thoroughness of training. He was steeped in the traditions of the German universities, and he carried on his classes with the same punctilious regard for the amenities which characterized these universities during his student days. Education and the training for a career were to him serious matters, and he gave of his very best to the students, expecting their best in return. In consequence, he turned out a number of excellent students.

In his investigations Dr. Mottier also showed the same thoroughness and exactitude. He was an extremely careful and painstaking worker, an artist, with a fine feeling for perfection in all the technical processes involved. Many microscopical preparations remain to testify to the excellence of fixation and the beauty of staining which characterized his technique, and many drawings are extant which show the same flair for finesse in technique and for artistic expression.

Dr. Mottier is especially well known for his work in plant cytology, in which field he published numerous papers dealing with mitosis, meiotic phenomena, sporogenesis and embryogeny in Pteridophytes and Spermatophytes. During his earlier years he was one of the leading proponents of the telosynoptic interpretation of meiotic behavior, a position from which he never publicly withdrew. In later years he was more concerned with cytoplasmic structure and with problems of growth under controlled conditions. Particularly significant was his work on fern prothallia. By preventing fertilization he kept fern gametophytes alive indefinitely. Some lived as long as ten years, and attained large sizes, closely resembling liverworts. In addition to his researches, Dr. Mottier found time to produce the widely known "College Textbook of Botany" and other books.

Dr. Mottier was a life member of the Botanical Society of America, a fellow of the American Association for the Advancement of Science, a member of the Washington Academy of Sciences, American Society of Naturalists, Indiana Academy of Science (president in 1907), Sigma Xi and Phi Beta Kappa.

The influence of Dr. Mottier will long be felt, both in Indiana University and in the wider field of botany to which he gave so unstintingly. He will be greatly missed by colleagues and students, who valued his friendship and who gained greatly from the high idealism which he manifested in all his activities.

RALPH E. CLELAND

RECENT DEATHS AND MEMORIALS

DR. MAYNARD M. METCALF, formerly professor of zoology at Goucher College and Oberlin College, later research associate at the Johns Hopkins University, died on April 19 at the age of seventy-two years.

DR. BERNARD FANTUS, professor of therapeutics at the College of Medicine of the University of Illinois in Chicago, died on April 14 in his sixty-sixth year.

DR. EDWARD JOHN ANGLE, a specialist in dermatology and genetic urinary surgery at Lincoln, Nebr., formerly a professor in the College of Medicine of the University of Nebraska, died on April 25 at the age of seventy-six years.

DR. ESTHER WADSWORTH WHEELER (née Hall) died on April 15. She was the first recipient of the D.Sc. degree from Radcliffe College (1921). Since her marriage in 1921 she had collaborated in research on ants with her husband, Dr. George C. Wheeler, of the University of North Dakota.

DR. ALFRED CORT HADDON, anthropologist and ethnologist, formerly president of the Royal Anthropological Institute, died on April 20 at Cambridge. He was eighty-four years old. Dr. Haddon served from 1880 until 1901 as professor of zoology at the Royal College of Science in Dublin, later becoming lecturer at Cambridge and the University of London. He organized and conducted scientific expeditions to the Torres Straits and New Guinea.

PROFESSOR KARL BOSCH, chairman of the I. G. Farbenindustrie A. G., died on April 26. He was sixty-five years old. In 1931 Dr. Bosch and Dr. Friedrich Bergius shared the Nobel Prize for chemistry—Dr. Bosch for his work with synthetic ammonia and Dr. Bergius for his process of making gasoline from coal.

A MEMORIAL meeting in honor of the late Margaret Floy Washburn was held at Vassar College on April 14. Representing the American Psychological Association, President Leonard Carmichael, of Tufts College, delivered the principal address. President Henry Noble MacCracken spoke in appreciation of Professor Washburn's distinguished services to Vassar College.

THE letters and papers of the late John Jacob Abel have been deposited in the Institute of the History of Medicine, the Johns Hopkins University, for cataloguing. The institute would greatly welcome any letters written by him prior to 1915. They will be transcribed and promptly returned. Please communicate with Miss Helen T. Konjias, 1900 E. Monument Street, Baltimore.

SCIENTIFIC EVENTS

THE COLORADO ROCKY MOUNTAIN OBSERVATORY OF HARVARD UNIVERSITY

HARVARD UNIVERSITY will erect the world's highest astronomical observatory this summer in the Colorado Rocky Mountains. The station will be equipped with a coronagraph, a new instrument for creating artificial solar eclipses and making possible regular observations of the corona and also of other phenomena of the sun's atmosphere.

The observatory will be located at Fremont Pass, Climax, Colorado, at an altitude of 11,318 feet. It will have the only coronagraph in the Western Hemisphere, and the third such instrument now operating in the world. The station will be built on the property of the Climax Molybdenum Company, through whose cooperation the new observatory was made possible. Harvard already has stations at Cambridge and Oak Ridge, Mass., and at Bloemfontein, South Africa. Professor Donald H. Menzel, of Harvard Observatory, is in charge of setting up the new coronagraph station.

The coronagraph studies of such solar activities as sun-spots, solar prominences and the corona and of the interrelationships of these activities, promise also to lead to greater knowledge of physical conditions on the sun and the relationships between the earth and its star neighbor.

Until the recent invention of the coronagraph by the French astronomer, Dr. Bernard Lyot, the solar corona could only be observed during total eclipses, when the moon cuts off the intense light of the sun ball. Of major importance for coronagraph observations is the selection of a high-altitude site, where the clearest possible sky prevails, free from dust and other suspended particles. Dr. Menzel spent some time last summer investigating various sites in the Rocky Mountains before selecting the location at Fremont Pass. The Harvard coronagraph, which has been under construction for three years, employs the same basic principles as Dr. Lyot's instrument. A special feature of the Harvard instrument will be the treatment of the lenses with the invisible-glass technique developed at Massachusetts Institute of Technology by Dr. C. H. Cartwright. This treatment helps to cut down reflections and scattered light in the instrument.

The coronagraph is not adapted as yet to replace natural eclipse observing altogether. For one thing there is difficulty in studying the blue and violet regions of the spectra, because the sky light is very intense in these regions. But for many purposes it provides excellent records, with the principal advantage that observations can be made every clear day, and do not have to await the eclipses.

Equipment at the Harvard station will include a powerful spectrograph for the study of the spectrum of the corona. Studies of the motions of solar prominences will be made with color filters as well as motion pictures. Movies will also be made of the corona, giving the first record of how this peculiar light structure changes from day to day and how its streamers project into space.

FELLOWS OF THE LALOR FOUNDATION

THE Board of Trustees of the Lalor Foundation has announced the names of the winners of seven awards for research in chemistry for the academic year 1940–41. These awards this year amount to $14,650. They are designed to enable men and women of outstanding ability to carry on special investigations at important research centers in the United States or abroad. The recipients of the awards were chosen from a group of forty-one candidates representing applicants working in the major fields of chemistry and related sciences.

The applications received indicate a wide-spread interest in these fellowships, 56 per cent. having come from candidates from universities in the eastern United States, 17 per cent. from the Middle West, 8 per cent. from the South, 17 per cent. from the Far West and 2 per cent. from candidates outside the boundaries of the United States.

As respects institutions where applicants elected to carry on their research, 63 per cent. selected eastern universities, 10 per cent. middle western institutions, 22 per cent. the far west and 5 per cent. chose universities outside of the United States. The fellowships include two for work at the California Institute of Technology and one each for work at the University of Chicago, Columbia University, the Johns Hopkins University, the Massachusetts Institute of Technology and Yale University.

The recipients of the awards are:

DR. ANDREW CALVIN BRATTON, instructor in pharmacology at the Johns Hopkins University Medical School, to continue work with Dr. E. K. Marshall on chemical

aspects of chemotherapy of compounds of the sulfanilamide type.

DR. ROBERT BYRON JACOBS, of the research laboratory of physical chemistry of the Massachusetts Institute of Technology, to continue work with Dr. F. G. Keyes on the fundamental properties of materials at low temperatures.

DR. JOSEPH O. HIRSCHFELDER, research associate at the University of Wisconsin, to work with Dr. Linus Pauling, of the California Institute of Technology, in an investigation of the best ways and means for calculating the quantum mechanical energy of molecules.

DR. JANE ANNE RUSSELL, of the University of California, to continue biochemical investigations under Dr. C. N. H. Long at Yale University School of Medicine.

DR. ROBERT M. SIMHA, from the University of Vienna, to work with Professor V. K. LaMer at Columbia University on the statistical problems and kinetics of polymerization in long chain compounds.

DR. E. L. ROBERT STOKSTAD, biochemist, Western Condensing Company, Berkeley, Calif., to work with Professor H. Borsook at the California Institute of Technology on Vitamin Factor U and an unknown factor in polished rice.

DR. ROBERT P. WALTON, professor of pharmacology, School of Medicine, University of Mississippi, for chemical and clinical work at the University of Chicago.

The Selection Committee acting for the foundation consisted of Dr. Roger Adams, director of the Department of Chemistry of the University of Illinois; Dr. Hans T. Clarke, professor of biochemistry, Columbia University; Dr. Charles A. Kraus, director of the department of chemistry of Brown University; Dr. Arthur B. Lamb, dean of the Graduate School of Arts and Sciences of Harvard University, and C. Lalor Burdick, secretary of the Lalor Foundation.

THE WILLIAM LOWELL PUTNAM MATHEMATICAL COMPETITION AWARDS

THE Department of Mathematics of the University of Toronto, Toronto, Ontario, has won the first prize of $500 in the third annual William Lowell Putnam Mathematical Competition, Professor W. D. Cairns, secretary-treasurer of the Mathematical Association of America, has announced. The members of the winning team were W. J. R. Crosby, J. C. Maynard, G. H. K. Strathy. The second prize of $300 is awarded to the Department of Mathematics of Yale University, New Haven, Connecticut, members of whose team were J. E. Brewster, A. M. Gleason, G. R. MacLane. For the third prize of $200 there is a tie between the Department of Mathematics of Columbia University and the Department of Mathematics of Cooper Union Institute of Technology, both in New York City. The members of the Columbia University team were Laurence Annenberg, Julius Ashkin, Paul Marcus; the members of the Cooper Union team were Murray Klamkin, Benjamin Lax, Samuel Manson.

In addition to these prizes to the departments of mathematics with winning teams, a prize of $50 each is awarded to the following five persons whose scores ranked highest in the six-hour examination: (names arranged alphabetically) W. J. R. Crosby, University of Toronto; A. M. Gleason, Yale University; E. L. Kaplan, Carnegie Institute of Technology; J. C. Maynard, University of Toronto; R. M. Snow, George Washington University. One of these five will later be chosen to receive a $1,000 year scholarship at Harvard University, this award to be announced later. The members of the four winning teams will receive individual cash prizes according to the ranks of their teams, and all individuals receiving prizes will also receive medals.

Honorable mention has been awarded this year to three teams and to five individuals. The teams are from the Department of Mathematics, University of California, Berkeley, members being Julia H. Bowman, W. M. Kincaid, C. W. Lippman; the Department of Mathematics, University of California at Los Angeles, members being Richard Arens, Robert James, Harold Shniad; and the Department of Mathematics, Carnegie Institute of Technology, Pittsburgh, members of the team being S. N. Foner, E. L. Kaplan, W. E. Stuermann. The five individuals receiving honorable mention are: G. R. MacLane, Yale University; Samuel Manson, Cooper Union Institute of Technology; Paul Marcus, Columbia University; G. H. K. Strathy, University of Toronto; J. E. Wilkins, Jr., University of Chicago.

The third annual William Lowell Putnam Mathematical Competition was held on March 2, 1940, and 208 undergraduate mathematics students from 68 colleges and universities in the United States and Canada took part. Qualified readers graded the examination books, complete anonymity being maintained throughout by the use of numbers instead of names for identification.

The first competition was held in April, 1938, and the second in March, 1939. This competition was designed to stimulate a healthful rivalry in the undergraduate work of mathematics departments in colleges and universities in the United States and Canada, and is open only to undergraduates. The examination questions were taken from the fields of calculus, higher algebra, differential equations and geometry.

The Putnam Competition is made possible by the trustees of the William Lowell Putnam Intercollegiate Memorial Fund, left by Mrs. Putnam in memory of her husband, a member of the Harvard class of 1882, and is sponsored by the Mathematical Association of America.

SYMPOSIUM IN THEORETICAL PHYSICS AT THE UNIVERSITY OF MICHIGAN

THE eighteenth Symposium in Theoretical Physics will be held at the University of Michigan in connec-

tion with the summer session between the dates of June 24 and August 16. While devoted largely to nuclear questions, other problems of present interest are included. In addition to the symposium lectures the regular bi-weekly colloquia will again be held. Further information about the symposium, including the opportunities for research and advanced study in the department during the summer, may be obtained by writing to the Director of the Department of Physics, University of Michigan.

The lectures will include:

Recent developments in the theory of the atomic nucleus, Professor Eugene P. Wigner, Princeton University, throughout the session.

Band spectra, Professor David M. Dennison, University of Michigan, throughout the session.

Theoretical aspects of cosmic rays, Professor George E. Uhlenbeck, University of Michigan, throughout the session.

Discussion of recent field theories, especially in connection with the theory of the meson, Assistant Professor Robert Serber, University of Illinois, June 24 to July 7.

Special topics of the theory of radiation and of the theory of radioactivity, Assistant Professor Wendell H. Furry, Harvard University, July 1 to July 14.

Low temperature physics; the properties of liquid helium; supra-conductivity, Professor Fritz W. London, Duke University, July 7 to July 28.

Recent experimental results in cosmic rays, Professor Bruno Rossi, University of Chicago, July 28 to August 5.

Holders of the Ph.D. degree in any of the physical sciences may attend the lectures as guests of the university without the payment of any fees. Requests for this privilege should be addressed to the president of the university.

THE SECTION OF PUBLIC HEALTH AND MEDICINE OF THE AMERICAN SCIENTIFIC CONGRESS

INFORMATION concerning the meeting of the American Scientific Congress, which will meet in Washington from May 10 to 18, has been printed in recent issues of SCIENCE. Surgeon-General Parran, secretary of the Section of Public Health and Medicine, has sent a tentative outline of the program of the section. It is as follows:

May 11, A.M.—General topic—*Education.* The bearing of popular, higher, professional and special education upon medicine and public health. (Joint session with Section on Education.)

May 13, P.M.—General topic—*Nutrition.* Summaries on status of recognized avitaminoses. Relation between nutritive state and some aspects of heart disease. Relation between drinking water and dental caries and mottled enamel. Recent observations on ariboflavinosis.

May 14, A.M.—Joint session with Section on Statistics. P.M.—Visit to National Institute of Health. Observation of current investigations in many branches. Visitors may concentrate if they desire on subjects of personal professional interest.

May 15, A.M.—General topic—*Tuberculosis.* Social and economic factors in etiology. Changes in clinical types encountered. Constitution of tubercle bacillus and its antigenic fractions. An epidemiological paradox of tuberculosis and possible explanations. New methods of treatment. P.M.—General topic—*Chemotherapy.* Chemistry and pharmacology of new compounds. Clinical applications to infections with streptococci, gonococci, pneumococci, meningococci, to lymphogranuloma venereum, and other infections. Experimental results of premise.

May 16, A.M.—General topic—*Heart Disease.* New conceptions from clinical viewpoint. Epidemiological features of rheumatic heart disease. Incidence and importance of etiologic forms of heart disease. Physiologic considerations of resuscitation. P.M.—General topic—*Cancer.* Present status of experimental cancer. Organization for cancer study and control. Newer aspects of therapy.

May 17, A.M.—General topic—*Tropical and Other Diseases.* Summaries and new contributions on yellow fever, pinto, leprosy, undulant fever, rickettsial diseases, plague.

ELECTIONS OF THE NATIONAL ACADEMY OF SCIENCES

AT the annual meeting of the National Academy of Sciences held in Washington on April 22, 23 and 24, under the presidency of Dr. Frank B. Jewett, new members of the academy were elected as follows:

Rollin Thomas Chamberlin, professor of geology, University of Chicago.

Carl Ferdinand Cori, professor of pharmacology, School of Medicine, Washington University, St. Louis.

George Washington Corner, professor of anatomy, Strong Memorial Hospital, University of Rochester.

Louis Frederick Fieser, professor of chemistry, Harvard University.

Wendell Mitchell Latimer, professor of chemistry, University of California at Berkeley.

Karl Friederich Meyer, professor of bacteriology and director of the Hooper Foundation, University of California.

James Bumgardner Murphy, member of the Rockefeller Institute for Medical Research.

Isidor Isaac Rabi, professor of physics, Columbia University.

Stephen Walter Ranson, professor of neurology and director of the Neurological Institute, Northwestern University.

William Jacob Robbins, director, New York Botanical Garden.

Richard Edwin Shope, Rockefeller Institute for Medical Research, Princeton, N. J.

William Hay Taliaferro, professor of parasitology, University of Chicago.

Stephen Timoshenko, professor of engineering mechanics, Stanford University.

Ernest Glen Wever, associate professor of psychology, Princeton University.

Claus Hugo Hermann Weyl, professor of mathematics, Institute for Advanced Study, Princeton.

Foreign associates were elected as follows:

Bernardo A. Houssay, facultad de medicina, Instituto de Fisiologia, Buenos Aires, Argentina.

James P. Hill, professor emeritus of embryology, University of London.

Giuseppe Levi, visiting professor, Institute of Pathology, University of Liège.

Sir Henry Dale, National Institute for Medical Research, Hampstead, England.

Dr. L. J. Henderson, Lawrence professor of chemistry, Harvard University, was reelected foreign secretary for a term of four years, beginning on July 1. Dr. J. C. Hunsaker, head of the department of mechanical engineering, Massachusetts Institute of Technology, was elected to succeed Dr. Arthur Keith as treasurer for a term of four years, beginning on July 1.

Members of the council elected were: Samuel A. Mitchell, professor of astronomy and director of the McCormick Observatory, University of Virginia, to succeed the late F. K. Richtmyer, for the term ending June 30, 1941; W. Mansfield Clark, De Lamar professor of physiological chemistry of the School of Medicine of the Johns Hopkins University, succeeding H. S. Jennings, for the term ending June 30, 1943; Oswald Veblen, professor of mathematics at the Institute for Advanced Study, Princeton, was reelected for the term ending June 30, 1943.

SCIENTIFIC NOTES AND NEWS

DR. HERMAN LEROY FAIRCHILD, professor of geology emeritus of the University of Rochester, observed his ninetieth birthday on April 29.

DR. WALTER B. CANNON, George Higginson professor of physiology in the Harvard Medical School, retiring president of the American Association for the Advancement of Science, has been elected a foreign member of the Royal Academy of Science of Sweden and also an honorary fellow of the National Academy of Medicine of Mexico.

THE honorary degree of doctor of agriculture of the North Dakota Agricultural College will be conferred on H. H. Kildee, dean of the Division of Agriculture at the Iowa State College at Ames, and on M. L. Wilson, head of the Federal Extension Service.

THE University of Aberdeen on April 4 conferred the doctorate of laws on Sir William Jameson, professor of public health at the University of London, and on Professor F. A. Lindemann, professor of experimental philosophy at the University of Oxford.

DR. FRANZ BOAS, emeritus professor of anthropology at Columbia University and chairman of the Committee for Democracy and Intellectual Freedom, was presented on April 20 with the annual award of the American Federation of Teachers for "outstanding services in the cause of education for democracy."

THE William Bowie Medal of the American Geophysical Union was presented at the recent Washington meeting to Dr. Arthur L. Day, formerly director of the Geophysical Laboratory of the Carnegie Institution of Washington. The presentation was made by Dr. T. Wayland Vaughan, emeritus director of the Scripps Institution of Oceanography. The medal was established in 1939 as an award "for outstanding researches on problems in geophysics." It is named in honor of Major William Bowie, of the U. S. Coast and Geodetic Survey.

A PORTRAIT of the late Dr. James Tate Mason, of Seattle, was presented to the Department of Medicine of the University of Virginia, Charlottesville, on April 13, by members of his class at the university and other friends. Dr. Mason died in 1936 a few weeks after he had been installed *in absentia* as president of the American Medical Association.

PROFESSOR R. J. POOL, of the department of botany of the University of Nebraska, was honored at a dinner given at the Student Union on the evening of April 20, "in recognition of his service of thirty-three years as a teacher in the department, during the last twenty-five years as chairman." The department was founded in 1884 by Dr. Charles Edwin Bessey, who was its head until his death in 1915. There have been but two administrative heads of the department since its establishment fifty-six years ago. The dinner was followed by an informal program, at the close of which Dr. Pool was presented with a bound volume containing letters of congratulation from a hundred and thirty-two former graduate students of the department and from other professional friends throughout the world.

THE 1940 medal of the Canadian Society of Chemical Industry will be presented to Fred J. Hambly, of the Electric Reduction Company, Ltd., Buckingham, Quebec, at the annual convention in May of the Canadian Chemical Association.

THE Iron and Steel Institute, London, has awarded the Bessemer Gold Medal for 1940 to Dr. Andrew McCance, of Glasgow, in "recognition of his eminent services in connection with the application of science to the iron and steel industry."

DR. DETLEV W. BRONK, professor of biophysics

and director of the Institute of Neurology and of the Johnson Foundation for Medical Physics at the University of Pennsylvania, has been appointed professor of physiology and head of the department of physiology and biophysics at Cornell University Medical College. Dr. Bronk succeeds Dr. Joseph C. Hinsey, who recently resigned the professorship of physiology to become professor of anatomy and head of that department. Other new appointments, all from the University of Pennsylvania, are Dr. H. Keffer Hartline, associate professor; Drs. Arthur J. Rawson, John P. Hervey and M. G. Larrabee, assistant professors, and Frank Brink, instructor. Dr. Dayton J. Edwards and Dr. Wm. H. Chambers continue as associate professors in the department.

DR. FRED C. KOCH, professor of physiological chemistry at the University of Chicago and chairman of the department of biochemistry, has been appointed Frank P. Hixon distinguished service professor of biochemistry. He succeeds Dr. Anton J. Carlson, who will retire with the title emeritus at the end of the current year.

DR. EVERETT STANLEY WALLIS, associate professor of chemistry at Princeton University, has been promoted to the rank of professor and has been designated A. Barton Hepburn professor of organic chemistry. He succeeds Professor Lauder W. Jones, who retired in 1937 after serving for seventeen years. The professorship was established by Mr. Hepburn in 1919.

DR. WILLIAM G. YOUNG, associate professor of chemistry at the University of California at Los Angeles, has been named chairman of the department of chemistry to succeed the late Dr. William Conger Morgan.

PROFESSOR LASZLO LECHMEISTER, of the University of Pécs, Hungary, whose investigations of carotenoids and other naturally occurring substances are well known, has been appointed professor of organic chemistry in the California Institute of Technology and is now in residence in Pasadena.

Nature states that Professor F. L. Warren, formerly of the Fuad I University, Cairo, has been appointed professor of chemistry in the Natal University College, Pietermaritzburg.

THE National Tuberculosis Association has approved a grant of $500 to the University of Minnesota for a study under the direction of Dr. Arthur T. Henrici, of the department of bacteriology, for an investigation of the acidfast actinomycetes in relation to tuberculosis.

DR. W. REID BLAIR, who has been connected with the New York Zoological Society for thirty-eight years, since 1926 as director of the New York Zoological Park, retired from active service on May 1.

DR. JAMES STOKLEY has resigned as director of the Buhl Planetarium and Institute of Popular Science, Pittsburgh.

AT the New Orleans meeting of the American Society for Pharmacology and Experimental Therapeutics, Dr. Carl F. Schmidt, professor of pharmacology and experimental therapeutics at the University of Pennsylvania and vice-president of the society, was elected editor of the *Journal of Pharmacology and Experimental Therapeutics* for a three-year term to succeed Dr. Paul D. Lamson.

AN expedition to collect fossil remains for the Field Museum of Natural History left Chicago on April 29 under the leadership of Paul O. McGrew, of the division of paleontology. Other members of the expedition are Orville Gilpin, of Chicago, and John Schmidt, of Homewood, Ill. Most of the summer will be spent along the Pine Ridge escarpment of northwestern Nebraska, southwestern South Dakota and eastern Wyoming.

DR. ALBERT W. C. T. HERRE, curator of ichthyology at the Natural History Museum of Stanford University, left on April 27 for a scientific tour of the Philippines, Malaya, Burma and India. He will investigate fisheries for the U. S. Bureau of Fisheries, and will collect cold-blooded vertebrates.

DR. PERRIN H. LONG, associate professor of medicine at the Johns Hopkins University, gave the sixth lecture in the series of "Lectures to the Laity on the Art and Romance of Medicine" at the New York Academy of Medicine on April 25. The title of his lecture was "Chemical Warfare Against Disease."

THE Christian A. Herter Lectures for the session 1939–1940 at the New York University College of Medicine were delivered on April 9 and 10 by Dr. Lowell J. Reed, dean and professor of biostatistics at the Johns Hopkins University School of Hygiene and Public Health. The subject of the lectures was "Public Health Problems as Related to Population Growth."

PROFESSOR PETER DEBYE, Baker visiting lecturer at Cornell University, will give a John Howard Appleton lecture at Brown University on Friday, May 10. He will speak on "Experimental Analysis of Thermal Motion." On May 3 Professor Harold C. Urey, of Columbia University, gave an Appleton lecture on "The Separation of the Isotopes of Carbon by Chemical Means."

THE ninth annual James Arthur Lecture of the American Museum of Natural History on the "Evolution of the Human Brain" was given by Dr. John F. Fulton, of Yale University, on the evening of May 2. His subject was "A Functional Approach to the Evolution of the Primate Brain."

PROFESSOR IRVINE MCQUARRIE, professor of pediatrics and head of the department of the University of Minnesota, who is visiting professor of pediatrics at the Peiping Union Medical College, addressed the eighth annual meeting of the Sigma Xi Club of Peking on May 4 on "The Significance of Water Metabolism in Health and Disease."

THE western summer meeting of the American Physical Society will be held at the University of Washington, Seattle, from June 18 to 21, in affiliation with the Pacific Division of the American Association for the Advancement of Science. In the East the summer meeting will be held at Pittsburgh on June 20, 21 and 22.

THE department of psychology of the University of California at Los Angeles will celebrate its first semester in its new building on the afternoon of June 13 by presenting a program of four papers. The speakers and their subjects will be as follows: Dr. George M. Stratton, University of California at Berkeley, "Social Psychology"; Dr. Milton Metfessel, University of Southern California, "Criminal Psychology"; Dr. E. R. Hilgard, Stanford University, "Experimental Psychology"; and Dr. R. B. Loucks, University of Washington, "Physiological Psychology." In the evening there will be a social gathering for invited guests and members of the Western Psychological Association, which meets on June 14 and 15.

A SYMPOSIUM on "The Social Function of Science" will be held at the Engineering Societies Building, New York City, on May 9 at 8:15 P.M. by the New York Branch of the American Association of Scientific Workers. The symposium will be a report of the work of a committee and will consist of the following: Introduction, A. Sandow; Historical Aspects of the Science-Society Relationship, C. H. Fuchsman; Science and Education, H. Rogosin; the Organization of Scientific Research, S. A. Karjala; Misapplication and Suppression of Science, E. Kabat. These papers, while individually presented, are the result of discussions of the committee, which, in addition to the speakers, includes N. Boroff and C. Hyman.

DR. W. H. TWENHOFEL, of the University of Wisconsin, visited the Agricultural and Mechanical College of Texas at College Station, from April 16 to 20. While there, he delivered a series of eight lectures on the general topic, "Phases and Problems in Sedimentary Geology." This series of lectures was sponsored by the department of geology and was intended to be of help in Gulf Coast stratigraphy. On Saturday, April 20, a short field trip was arranged for members of the Houston Geological Society and others, followed by a general afternoon conference on "Local Cycles of Sedimentation in Subsurface Correlations." In the evening, a banquet was given by the Geology Club of the Agricultural and Mechanical College. Dr. Twenhofel was made an honorary life member of the club.

THE eighteenth annual meeting of the Georgia Academy of Science was held at Emory University, Atlanta, on April 5 and 6 with an attendance of approximately a hundred and fifty. The program included papers on agriculture, biology, chemistry, mathematics, medicine and physics. Members of the academy and visitors were guests of Emory University at a dinner on Friday evening. After the dinner Dr. Roy R. Kracke, of the Medical School, discussed the relation of certain drugs to blood diseases. The fourth annual meeting of the Georgia Entomological Society was held following the meeting of the academy on April 6 with twenty-five entomologists from various points in the state in attendance. The nineteenth annual meeting of the academy will be held at Wesleyan College, Macon, on April 4 and 5, 1941. Officers for the coming year are: *President,* R. B. Holt, Agnes Scott College; *Vice-president,* W. B. Baker, Emory University; *Secretary-Treasurer,* Geo. H. Boyd, University of Georgia.

THE Medical School, at Chicago, of Northwestern University has received a bequest in excess of $2,000,000 for the erection and endowment of a hospital and for medical research from the estate of Mrs. Margaret Gray Morton. The new hospital will be the fourth medical unit to be built. Recent gifts from G. Herbert Jones, steel manufacturer, are now enabling Wesley Hospital to erect a $2,500,000 building as the third unit in the medical center. Mrs. Morton's bequest is the third large gift received by the university. In March, 1939, $6,735,000 was received from the Walter P. Murphy Foundation of Chicago for the establishment of the Northwestern Technological Institute, and in December $1,500,000 from the estate of Clara A. Abbott for the advancement of medical and surgical science.

A GROUP of psychologists holding the doctor's degree will be given an opportunity to study and conduct research at the Summer Station in Psychology of Cornell University as guests of the university. No tuition or other fees will be charged the guests, unless they are actually enrolled in the regular summer session of the university. Those holding doctor's degrees will be given the status of resident doctors with all the rights and privileges of university membership. Dr. Madison Bentley, emeritus professor of psychology and now psychological consultant on the staff of the Library of Congress, will be in attendance throughout the session. He will assist the departmental staff in placing the facilities of the university at the disposal of the members of the station and in arranging seminars on subjects selected by them.

THE Chicago Section of the American Chemical Society plans to hold an American Chemical Exposition from December 11 to 15 at the Stevens Hotel. Arrangements will be in the hands of leading chemists in the Chicago area and the exposition will have the support and cooperation of national groups, that will officiate in an advisory character. The exhibits will stress the application of chemistry in industry and will reveal many new processes and new developments.

DISCUSSION

VITAMIN L AND FILTRATE FACTOR

LAST year Morgan and Simms[1] reported *inter alia* that "if the mother rats were deprived of the filtrate factor from the day of mating the litters were of normal size and weight, but none could be reared to weaning age." More recently, Sure[2] found that in albino rats complete failure of lactation resulted with the supplement of crystalline thiamin, riboflavin, vitamin B_6, choline and nicotinic acid, and the addition of factor W (filtrate factor) concentrate resulted in success in every trial. In the words of Sure, if there exist needed components other than those just named "these unidentified substances must have been furnished by the solution containing W factor, which was prepared from liver extract." Thus the question of the specific factor for lactation has been narrowed down to the filtrate factor fraction, the fraction in which we found our vitamin L.[3]

Since our first publication on the subject[4] we insisted that the failure of lactation (vitamin L deficiency) can be produced on diet entirely adequate for growth. We recently re-examined the subject and found that our vitamin L complex deficient diet, consisting of polished rice powder 75 g. purified fish protein 10 g., butter fat 10 g., McCollum's salt mixture 5 g., supplemented with acid earth adsorbate of baker's yeast (yield from 10 g. of dried yeast), was absolutely adequate for growth, inasmuch as the growth of young rats on this diet was in no way inferior to that on a similar diet with whole brewer's yeast supplement, replacing acid earth adsorbate. In both cases, young rats weighing about 25 g. grew to about 200 g. in 10 weeks. Vitamin L deficiency produced by us is quite independent of filtrate factor deficiency.

The source of filtrate factor in our vitamin L complex deficient diet proved to be polished rice powder, since when this was extracted with dilute alcohol the L deficient diet above mentioned produced subnormal growth (filtrate factor deficiency).

Another evidence pointing to the non-identity of vitamin L and filtrate factor is based on the fact that two different substances (L_1 and L_2) are involved in vitamin L complex. For example, liver filtrate is an accepted source of filtrate factor and yet we know that it supplies only one (L_1) of the two components. Baker's yeast filtrate is potent as filtrate factor but we also know that it does not contain vitamin L_1. Evidence seems to be growing that the so-called filtrate factor consists of two or more components, but these component substances occur together in liver as well as yeast filtrates. We believe that it is impossible to identify vitamin L with filtrate factor, and that the filtrate factor in the sense of Morgan and Simms and the W factor concentrate used by Sure are mixtures of filtrate factor and vitamin L.

WARO NAKAHARA
FUMITO INUKAI
SABURO UGAMI

THE INSTITUTE OF PHYSICAL AND CHEMICAL RESEARCH, TOKYO

[1] A. F. Morgan and H. D. Simms, SCIENCE, 89: 565, 1939.

[2] B. Sure, *Jour. Nutrition*, 19: 57, 1940.

[3] W. Nakahara, F. Inukai and S. Ugami, SCIENCE, 87: 372, 1938.

[4] W. Nakahara and F. Inukai, *Sci. Pap. Inst. Phys. Chem. Research*, 22: 301, 1933.

THE ATTEMPTED CHARACTERIZATION OF MALIGNANT TISSUE PROTEIN WITH D-AMINO ACID OXIDASE

IN a recent paper, Lipmann, Behrens, Kabit and Burk[1] have reported results obtained by subjecting acid hydrolysates of normal and malignant tissue proteins to the action of d-amino acid oxidase. The average percentages of nitrogen liberated by the oxidase were as follows: for proteins (insulin, Bence-Jones protein, gliadin), 1.1 per cent.; for normal tissues, 1.8 per cent.; for one benign tumor, 1.8 per cent.; for malignant tissues, 1.7 per cent., and for one sample of leukemia tissue, 2.1 per cent. 71 to 87 per cent. of the d(−)glutamic acid nitrogen added to the tissue hydrolysates could be recovered. On the basis of these results, the above authors conclude that "whatever interest certain of Kögl's data may retain for general biochemistry, the main contention concerning malignancy specificity[2] is, for the cancer field, evidently no longer tenable." We are unable to agree that the results reported justify this conclusion. Our objections are discussed in the remainder of this communication.

(1) Certain amino acids, notably serine, proline, cystine and alanine, are partly racemized during acid

[1] SCIENCE, 91: 21, 1940.

[2] *i.e.*, that malignant tissue protein contains partly racemized glutamic acid residue, as well as small amounts of other slightly racemized residues (leucine, lysine, hydroxyglutamic acid, valine).

hydrolysis of proteins. It is to be expected, therefore, that d-amino acid oxidase will liberate small amounts of nitrogen from both normal and malignant tissues after such hydrolysis. If the amount of nitrogen liberated from these amino acids is of the same order of magnitude as that preexisting in the partly racemized glutamic acid reported by Kögl and others[3] to exist in malignant tissue proteins, then the d-amino acid oxidase method would seem to be unsuitable for the detection of such glutamic acid. Suppose, as an example, that 100 g of malignant tissue protein is assumed to have a nitrogen content of 15 g. If it is assumed that 5 g of glutamic acid are present in the hydrolysate of this protein, the glutamic acid nitrogen present will be 0.476 g. Even if this glutamic acid is completely racemized, the amount of d(−)glutamic acid present will be only 0.238 g, or 1.6 per cent. of the total protein nitrogen. This is of the same order of magnitude as the percentages of nitrogen liberated from normal and malignant tissues by d-amino acid oxidase; indeed, the nitrogen liberated from a carcinoma of the breast was found to be 3.7 per cent.

(2) In view of the recent report of Kögl, Erxleben, and Akkerman,[4] there seems to be little doubt that d(−)glutamic acid actually exists in acid hydrolysates of malignant tissue proteins. These authors have isolated, by two different methods, chemically pure d(−)glutamic acid from such hydrolysates.

L. EARLE ARNOW
JEANETTE C. OPSAHL
UNIVERSITY OF MINNESOTA

THE PEACE RESOLUTION OF THE AMERICAN ASSOCIATION OF SCIENTIFIC WORKERS

IMMEDIATELY after the outbreak of the European war in September, 1939, the members of the American Association of Scientific Workers attempted to crystallize their attitudes toward the conflict. This was done by discussions at membership meetings of the various branches, by communication between the branches and in discussion at two national committee meetings. From these discussions there resulted the following statement, which represents the attitude of a large majority of the members of the association.

Science is creative, not wasteful or destructive. Yet the same scientific advances which have contributed so immensely to the well-being of humanity are made to serve also in increasing the horrors of war. The present conflict in Europe focuses attention on this perversion of science.

The futility of war is especially clear to scientists, for war, as a method of solving human problems, is out of harmony with the rational spirit and objective methods of science. Wherever objective analysis is permitted, the great advantages of peaceful procedure in the adjustment of conflict become obvious. Scientists deplore the fact that the fruits of their efforts are exploited for the ends of death and destruction and look to the future when science will be employed only in the one struggle worthy of it—in man's never-ending contest with nature.

Scientists know that democracy and freedom of thought, which are precious to us both as citizens and as men of science, are endangered in the emotional turmoil which accompanies war. The continuance of progress now largely depends upon the scientists of the neutral nations. American scientists can best fulfill their share of this responsibility if the United States remains at peace.

We, the undersigned workers in science (including members of the American Association of Scientific Workers and other American scientists), therefore recommend to our fellow-citizens the wholehearted and unceasing support of all reasonable programs which seek a better undestanding of the causes of war, and which will preserve peace for the United States and bring peace to the world.

This statement, accompanied by a letter of explanation from Professor Arthur H. Compton, of the University of Chicago, chairman of the Mid-west Branch, is being mailed to many non-member scientists asking for their approval. When the signatures have been collected, it is planned to present the statement and the signatures to the President of the United States. Professor Compton's letter reads in part as follows:

May I ask your attention to the enclosed *Peace Resolution* adopted by the American Association of Scientific Workers, and if you approve it, please sign the resolution and return it. . . .

It is our desire to bring this resolution to the attention of the American public as expressing the earnest concern of American men of science in the maintenance of peace. The more nearly unanimous the responses to this request become, the more truly can we consider that this resolution represents the attitude of American scientists. . . .

Because of limited funds it has been impossible for the AASW to reach more than a small cross-section of the large numbers of American scientists. Others who approve the statement can signify their approval by writing Professor Compton.

ROBERT S. MULLIKEN
UNIVERSITY OF CHICAGO

SCIENTIFIC BOOKS

THE STONE AGE OF MOUNT CARMEL

The Stone Age of Mount Carmel. Vol. II. By THEODORE D. MCCOWN and SIR ARTHUR KEITH. 390 pp., 88 tables, 247 illustrations, 28 plates. Appendix, bibliography and index. Oxford University Press, 1939. $20.00.

[3] See bibliography given in the paper of Lipmann *et al.*

[4] *Z. physiol. Chem.*, 261: 141, 1939.

THIS monumental work is an invaluable addition to our knowledge of those Stone Age forms of man that immediately preceded our own species upon the Old World time scale. The book deals with the human remains recovered from caves on the slopes of Mount Carmel in Palestine. It is confined, however, to those specimens recovered from cultural levels indicated as Levalloiso-Mousterian, and approximating in date the Riss-Wurm interglacial. The post-Pleistocene Natufian skeletal material is reserved for a later monograph. The present work is entirely osteological in nature, the cultural material and associated fauna having been described in Volume I of this series, published in 1937 and authored by Dorothy Garrod and Dorothea Bate. The two volumes together constitute the final report of the expeditions to Palestine supported by the American School of Prehistoric Research, the British School of Archaeology, in Jerusalem, and the Royal College of Surgeons through the years 1929 to 1934.

Because of lay interest in the spectacular *Sinanthropus* finds near Peking, the Skhūl and Tabūn peoples have tended to escape notice. Actually the latter propound new problems to the student of human evolution, as well as carry back into pre-Wurmian time the dating for a human type approaching *sapiens* in several diagnostic particulars. The finds were unusual, not alone in the amazing degree of individual variation represented, but in the presence of delicate skeletal parts such as the bones of the hands and feet, which provided an exceptional opportunity for extended anatomical analysis not usually afforded the student of Pleistocene man. Two human types were found: the Skhūl people, represented by several individuals of both sexes, and—from another cave—two Neandertaloid specimens referred to as "Tabūn." The Tabūn individuals are clearly assignable to *neandertalensis,* and may be assumed to be roughly contemporaneous, geologically and culturally, with the Skhūl remains, or, at best, slightly earlier.

The Skhūl people, on the other hand, present problems to specific classification. They are characterized by a variable mixture of both paleoanthropic and neanthropic characteristics which reveal possible affinities with the Cro-Magnon stock and also with the Neandertal strain—a people, in short, somewhat intermediate in character between the two. The brain is well up in the modern range and essentially *sapiens* in type; adaptation to bipedal locomotion is perfect. After some hesitation and weighing of characters, however, the authors assign the Skhūl people to those forms of humanity showing a dominance of Neandertaloid traits. Hybridism as the result of contact between an early *sapiens* type and *neandertalensis* can not be ignored as a possible explanation of this mosaic of advanced and primitive features, although it is not the explanation favored by the authors. They incline to the view that "the abundance of neanthropic characters in Mount Carmel man is an indication . . . that he broke away from the stem of mankind emerging in western Asia during early Pleistocene times, at a date later than did the ancestral stock of the Neandertals of western Europe. Being later in his separation, Mount Carmel man has thereby come to have a larger degree of Neanthropic characters of the stock which ultimately produced the Cro-Magnon. . . ."

This interpretation projects our search for the earliest *Homo sapiens* farther into the East, and introduces a view which the authors foresee may prove unacceptable to Dr. Hrdlička. The latter would, in all probability, view the Skhūl intermediates as simple evidence of the active evolution of the Palestinian Neandertals into the *sapiens* type. The authors of the present volume, however, are good-naturedly tolerant of interpretations other than their own, and lay no claim to infallibility. They have succeeded in producing a work which, in outlook and erudition, marks another milestone in our search for human origins.

LOREN C. EISELEY
THE UNIVERSITY OF KANSAS

SOKOLNIKOFF'S ADVANCED CALCULUS

Advanced Calculus. By I. S. SOKOLNIKOFF. 446 pp. New York: McGraw-Hill Book Company. 1939.

THIS text is designed to follow one year's work in the calculus. In marked contrast to the familiar pattern of drill in technique and of numerous interesting applications to geometry and physics, this course provides special emphasis upon rigorous concepts of real variable analysis. In a well-coordinated, self-contained development the student is encouraged to acquire a critical attitude with regard to the existence of derivatives and integrals and the legitimacy of elementary operations in the calculus. The problem material is particularly well chosen to hint the wealth of possible later analytic developments. Much of what is often left to a graduate course is here made available in a substantial but not excessive program for one year's undergraduate work. Included are chapters devoted, respectively, to line integrals, applications of power series, Fourier series and implicit functions. The instructor must decide whether this solid unspiced fare, so well-prepared (patterned after selections from Goursat, Knopp and de la Vallée-Poussin), seems the best for the fleeting undergraduate semesters. In laying a solid foundation for the future analyst, the book affords little comfort to the technical problem-solver. This "advanced calculus" must in any case be followed

by a "higher course" if the calculus is to prove an effective working tool in the handling of problems originating outside of mathematics, since along with much else even the subject of differential equations has been postponed beyond this text.

BROWN UNIVERSITY ALBERT A. BENNETT

SOCIETIES AND MEETINGS

SPECIAL RESEARCH CONFERENCES ON CHEMISTRY

THE third series of conferences on chemistry, under the auspices of the Section on Chemistry of the American Association for the Advancement of Science, will be held at Gibson Island, Md., from June 17 to August 2. It will consist of six groups of papers and discussions in important fields of chemistry. Each of the six groups will occupy a period of five days, in each of which only one or a few formal papers will be presented, leaving ample time for discussions. In the following outline the paper or papers in each group, will be presented on successive days.

I. *Frontiers in Petroleum Chemistry.* June 17–21. C. R. Wagner, *chairman.* Program: Frederick D. Rossini, "The Analysis of Petroleum as Exemplified by Project No. 6 at the Bureau of Standards"; Gustav Egloff, "The Production of Aromatic Hydrocarbons from Petroleum"; E. V. Murphree, "Alkylation"; C. W. Montgomery, "Isomerization"; L. L. Davis, "Oxidation of Lubricating Fractions"; J. A. Boyd, "Investigations of the Combustion of Characteristics of Pure Hydrocarbons."

II. *Catalysis.* June 24–28. E. C. Williams, *chairman.* Program: Otto Beeck, "Modern Physical Methods in the Study of Catalysis"; R. B. Burk, "Theories of Polymerization and their Consequences"; P. H. Emmett, "Surface Area Measurements in Studying Catalytic Reactions"; Kenneth Blanchard, "Fermentation"; H. S. Taylor, "The Definition of Absorption and Surface Characteristics of Catalysis."

III. *Organic High Molecular Weight Type Compounds.* July 8–12. H. L. Bender, *chairman.* Program Committee: R. H. Kienle, S. S. Kistler and H. L. Bender. Program: E. O. Kraemer, "The Molecular Basis of Resin Behavior"; Emil Ott and H. M. Sprulin will conduct a discussion of high molecular weight compounds; H. Mark, "The Elastic Behavior of High Molecular Compounds"; W. T. Busse, "The Effect of Temperature and Hysteresis on the Tensile Properties of Rubber in Shear"; B. S. Garvey, Jr., "Mixed Polymers and Vulcanizable Plasticizers"; R. M. Fuoss, "Electrical Properties of Polyvinyl Chloride Plastics"; H. Hetenyi, "Photoelastic Tests with Heat Hardening Resins at Elevated Temperatures"; W. Sisson, "X-Ray Studies Regarding the Structure and Behavior of Cellulose Fibers"; Henry Eyring, "Rate Processes Involving Large Molecules."

IV. *Vitamins.* July 15–19. C. G. King, *chairman.* Program Committee: J. W. M. Bunker, A. D. Emmett and C. G. King. Program: H. C. Sherman, "Vitamin A Values: Determination by Bioassay and Interpretation in the Light of Natural Variations"; A. D. Holmes, leader of discussion; Harden F. Taylor, "Physico-chemical Methods of Vitamin A Assay"; Norris Embree, leader of discussion; E. M. Nelson, "The Development of Enforcement Policies Relative to Assays and Analyses"; H. T. Scott, "Problems and Possible Improvements in Vitamin D Bioassays"; N. A. Milas, "Physico-chemical Methods of Vitamin D Assay"; Walter C. Rissell, leader of discussion; S. B. Binkley and E. A. Doisy, "The Chemistry of Vitamin K"; S. Ansbacher, "The Bioassay of Vitamin K"; O. A. Bessey, "The Techniques of Analysis and Assay of Vitamin C"; C. J. Farmer, "Vitamin C Analyses in Relation to Clinical Problems"; D. K. Tressler, "Vitamin C Values in Fruits and Vegetables"; O. L. Kline, "Bioassays for Factors in the Vitamin B-Complex with Special Reference to Vitamin B_1"; C. N. Frey, A. S. Schultz and L. Atkin, "The Fermentation Method for the Determination of Thiamine"; C. H. Hunt, "The Anti-gray Hair Factor"; W. L. Sampson, "The Chemistry and Pharmacology of Vitamin B_6"; G. C. Supplee, "Bioassays and Chemical Tests for Riboflavin"; W. H. Sebrell, Jr., "Bioassay for Factors in the Vitamin B-Complex, with Special Reference to Nicotinic Acid"; Paul György, "Skin and Vitamins, with Particular Reference to the Vitamin B-Complex"; C. D. May, "Clinical Studies of Vitamin A Deficiency"; E. A. Sharp, "Anemias Associated with Vitamin Deficiencies"; Tom D. Spies, "Multiple Deficiencies Associated with Pellagra"; H. R. Butt, "Clinical Studies of Vitamin K Deficiency"; G. Dalldorf, "Clinical Studies of Vitamin C Deficiency."

V. *Relation of Structure to Physiological Action.* July 22–26. Walter Hartung, *chairman.* Program Committee: D. L. Tabern and Walter Hartung. Program: C. M. Suter, "The Syntheses and Bactericidal Properties of Phenolic Compounds"; R. S. Shelton, "Correlations of Chemical Structure and Germicidal Activity Among Some Quaternary Ammonium Salts"; Warner Carlson, "Cinchona Alkaloids: (I) "A Survey of the Relation of Structure to Anti-Malarial Action," (II) "Certain Biological Aspects of Anti-Pneumococcal Action"; Alice Renfrew, "Structure of Anti-Pneumococcic Activity and the Cinchona Series"; F. F. Blicke, "Chemistry of Antispasmodics"; C. W. Geiter, "Pharmacology and Evaluation of Antispasmodics"; A visit to the Baltimore hospitals; D. L. Tabern, "Intravenous Anesthesia"; Oskar Baudisch, "Biological Orientation in Minor Element Research: Formation, Reactivity and Structure of Chemical Groupings which Capture and Concentrate Elements Selectively."

VI. *Applications of X-Ray and Electron Diffraction.* July 29–August 29. Maurice L. Huggins, *chairman.* Program: J. L. Hoard, "X-Ray Studies of Complex Inorganic Compounds"; H. Mark, "X-Ray Studies of Long-Chain Compounds"; I. Fankuchen, "X-Ray Studies of Proteins"; D. M. Wrinch, "The Interpretation of X-Ray Data on Proteins"; Wm. L. Fink and D. W. Smith, "Preferred Orientations in Metals"; Charles S. Barrett, "X-Ray Diffraction from Strained Metals and Alloys";

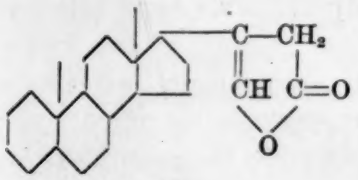
P. Debye, "Theory of X-Ray and Electron Diffraction"; J. Y. Beach, "Electron Diffraction Studies of Gaseous Molecules"; H. R. Nelson, "Electron Diffraction Studies of Solids and Solid Surfaces"; L. H. Germer, "Electron Diffraction Studies of Thin Films."

Since the accommodations on Gibson Island are very limited, it is advisable to make registration and reservations in advance. The registration fee is $3.00 per week per person, payable to Section C, A. A. A. S. On receipt of check, a registration card will be sent which will admit one to the island and entitle him to all the guest privileges of the island, including a reservation for a room. Rooms are $2.00 per day per person and board is *a la carte*. It is possible to make a few week-end reservations if made in advance. Any person making advance registration and reservations and finding later he is not able to attend may have his registration fee returned and his reservations cancelled, providing that a notice is received at least one week in advance of the date of the conference. The registration fee, request for room reservation or request for any additional information should be addressed to the Director of the Conferences, Neil E. Gordon, Central College, Fayette, Missouri.

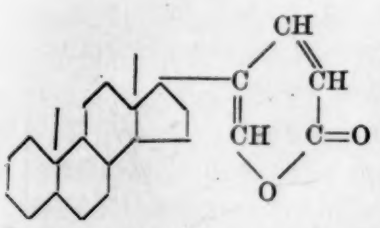
SPECIAL ARTICLES

SYNTHESES OF MODEL UNSATURATED LACTONES RELATED TO THE CARDIAC AGLYCONES

THE structures of the cardiac aglycones rest on a reasonably complete foundation as a result of the investigations of Jacobs, Windaus, Tschesche, Stoll and their collaborators.[1] For purposes of chemical classification the aglycones may be conveniently divided into two groups, *viz.*, those of the digitalis-strophanthus group the members of which are characterized by the presence of a side-chain consisting of the lactone of an enolized β-aldehydo-acid carrying the cyclopentanophenanthrene ring system on the β-carbon atom (type formula I), and those of the squill-toad venom group in which the cyclopentanophenanthrene ring system is present as a substituent in the 5-position of an α-pyrone ring (type formula II).



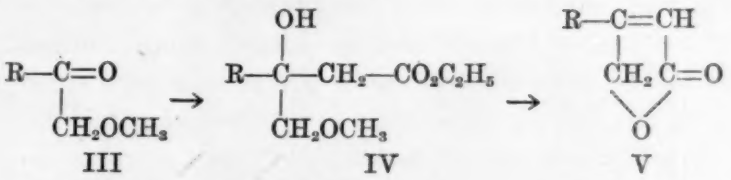
I



II

We have succeeded in synthesizing simple 5-substituted α-pyrones to serve as models for further work. Ethyl hexene-2-oate on condensation with ethyl oxalate in the presence of potassium ethylate gives diethyl 4-ethylhexene-2-on-5-dioate-1,6. This, after hydrolysis of the ester groups, on heating with hydrogen bromide in acetic acid yields 5-ethyl-6-carboxy-α-pyrone (calculated for $C_8H_8O_4$: C, 57.2; H, 4.8; found: C, 57.6; H, 4.9) which on distillation with copper powder yields 5-ethyl-α-pyrone.

At the same time we have been engaged in the synthesis of unsaturated γ-lactones related to the digitalis-strophanthus type, and have succeeded in preparing β-substituted $\Delta^{\alpha,\beta}$-unsaturated γ-lactones containing phenyl, cyclohexyl and *n*-butyl groups as representative substituents. ω-methoxy-methylketones (III) are readily prepared by the action of an appropriate Grignard reagent on methoxyacetonitrile.[2] These on condensation with ethyl bromoacetate in the presence of zinc give glycol-ether-esters (IV) which, after saponification of the ester, give unsaturated lactones (V) when heated with hydrogen bromide in acetic acid.[3]



III IV V

For the typical case where R is cyclohexyl: Calculated for $C_{10}H_{14}O_2$: C, 72.3; H, 8.5; found: C, 72.5; H, 8.8.

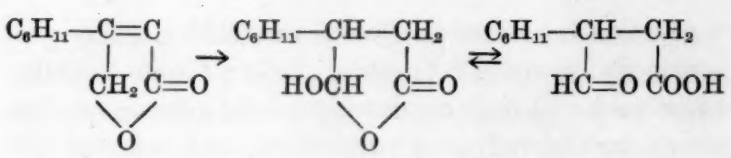
The properties of the latter lactones are not without interest. Thus the cyclohexyl lactone on treatment with a solution of potassium hydroxide in absolute methanol apparently undergoes irreversible isomerization to the $\Delta^{\beta,\gamma}$-lactone which adds the elements of water either during the reaction or during the subsequent working up to yield the hydroxylactone (VI). (Calculated for $C_{10}H_{16}O_3$: C, 65.2; H, 8.9; found: C, 65.7; H, 8.8.) Substances of the latter type have been shown to exist in equilibrium with the corresponding aldehyde-acid (VII).[4] The presence of both an aldehyde group and a carboxyl group in VI

[1] Elderfield, *Chem. Rev.*, 17: 187, 1935; Tschesche, *Ergeb. d. Physiol.*, 38: 31, 1936.

[2] Henze and Rigler, *Jour. Am. Chem. Soc.*, 56: 1350, 1934.

[3] Stoermer, *Ber.*, 39: 2297, 1906.

[4] Perkin, Jr., and Sprankling, *Jour. Chem. Soc.*, 75: 11, 1899; Harries and Alefeld, *Ber.*, 42: 159, 1909.



VI VII

or VII was shown by the preparation of the semicarbazone of the methyl ester. (Calculated for $C_{12}H_{21}O_3N_3$: C, 56.4; H, 8.3; found: C, 56.5; H, 8.5.)

The possible bearing of these observations on the structure of the cardiac aglycones and on the transformation of the aglycones into the iso-aglycones will be discussed in detail in a forthcoming communication.

JOSEF FRIED
MARTIN RUBIN
WALTER D. PAIST
ROBERT C. ELDERFIELD

DEPARTMENT OF CHEMISTRY,
COLUMBIA UNIVERSITY

NATURE OF THE PASTEUR ENZYME[1]

WHEN fermenting cells are brought in contact with oxygen, normally less carbohydrate is broken down and less fission products are formed. This phenomenon was discovered by Pasteur in 1861 and is to-day known as the Pasteur reaction. This effect has been interpreted in terms of an oxidative resynthesis of carbohydrate from the end products of fermentation (Meyerhof) of a suppression of fermentation by respiration (Warburg), and of an inhibition of fermentation dependent on the oxygen tension (Lipmann, Kempner, Laser). The selective inhibition of the Pasteur reaction by ethyl isocyanide,[2] by a lowering of the oxygen tension[3] and by suitable concentrations of carbon monoxide[4] indicates that a catalyst distinct from the respiratory enzyme is involved and that this agent contains heavy metal. The name *Pasteur enzyme* appears to be appropriate for this thermolabile catalyst.

The reversal of the carbon monoxide inhibition of the Pasteur effect by white light[4] has enabled us to apply the classical photochemical technique of Warburg to the study of the spectrum of the Pasteur enzyme. Rat retina was chosen for these experiments because its respiration remains unaffected by carbon monoxide at concentrations sufficient to inhibit the Pasteur enzyme.[4] The photochemical effect of monochromatic light of three different wave-lengths on the glycolysis in this system has been attributed by Warburg and Negelein[5] to the action of carbon monoxide and light on the respiratory enzyme causing a secondary effect on glycolysis. This view is no longer tenable in the light of Laser's observations,[4] which we have been able to confirm.

In the present work sixteen different wave-lengths of monochromatic light of high intensity have thus far been used for the charting of the relative photochemical absorption spectrum of the Pasteur enzyme in the visible region. The pattern obtained is that of an iron-porphyrin-protein, showing a high γ- or Soret band at 440–455 mμ, and lower β- and α-bands at 500–520 mμ and 570–590 mμ, respectively. The position of the maxima of these bands is indicated in the diagram (Fig. 1) together with the corresponding maxima of the bands of carbon monoxide hemoglobin and the carbon monoxide complex of the respiratory enzyme.

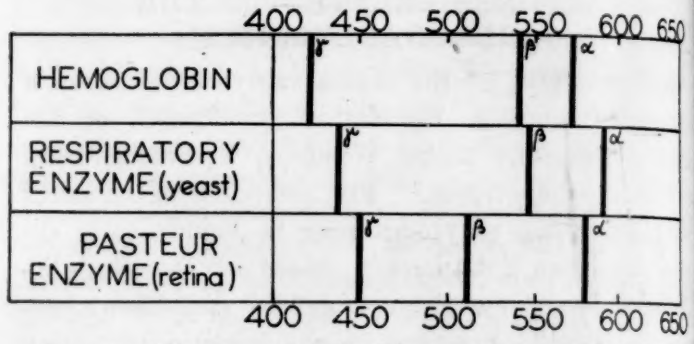


FIG. 1. Diagram showing the position of the absorption maxima of the carbon monoxide compounds of hemoglobin, the respiratory enzyme in yeast (Warburg) and the Pasteur enzyme in retina (present work) in the visible region of the spectrum.

A well-defined band at 450 mμ has also been recorded by direct spectrography of carbon monoxide-treated rat retinas. This band coincides in position with the main or γ-band of the Pasteur enzyme as revealed by the photochemical experiments.

The Pasteur enzyme in retina appears to be a pheohemin protein like the respiratory enzyme in yeast and in Acetobacter. It differs from them with regard to its affinity for carbon monoxide and oxygen as well as the position of the absorption bands of the carbon monoxide compound.

KURT G. STERN
JOSEPH L. MELNICK[6]
DELAFIELD DUBOIS

YALE UNIVERSITY SCHOOL OF MEDICINE

PROLIFICACY OF RATS TREATED WITH MARE GONADOTROPIC HORMONE

As an earlier paper[1] has demonstrated, adequate amounts of mare gonadotropic hormone will produce superovulation and estrus in immature rats. Mating of these rats[2] resulted in the implantation of as many

[1] This work was aided by a grant from the Jane Coffin Childs Memorial Fund for Medical Research.
[2] O. Warburg, *Biochem. Zeitschr.*, 172: 432, 1926.
[3] H. Laser, *Biochem. Jour.*, 31: 1671, 1937.
[4] *Ibid.*, 31: 1677, 1937.
[5] O. Warburg and E. Negelein, *Biochem. Zeitschr.*, 214: 101, 1929.

[6] Finney-Howell Research Foundation fellow, 1939–40.
[1] H. H. Cole, *Amer. Jour. Anat.*, 59: 299–331, 1936.
[2] H. H. Cole, *Am. Jour. Physiol.*, 119: 704–712, 1937.

as 28 normal-appearing fetuses. Further, 2 of 14 rats which were allowed to bear their young had 17 living young each. Apparently Engle[3] misinterpreted this report, for he states regarding it, "Immature animals, however, showed superfecundity, but these immature animals were not permitted to carry their young to term so that the number of viable young is unknown."

In experiments relating to the effect of pregnancy on growth we have bred about 100 more rats after the induction of precocious sexual maturity with mare gonadotropic hormone. These rats were given 8 rat units in a single injection at ages ranging from 30 to 33 days and were bred within 72 hours after the injection. In one instance 30, in another 32, and in still another 33 fetuses were found at midpregnancy, though some were in advanced stages of resorption.

The question arises, therefore, as to how many remain viable throughout pregnancy. We previously reported[2] finding 23 living young *in utero* on the 21st day of pregnancy. In the present series the uterus of one rat contained 20 on the 21st day of pregnancy; that of another, 23 living young on the 20th day. One rat (G7474), given 8 rat units on the 33rd day and bred 3 days later, gave birth to 23 living young on the 60th day of age.[4] The young, aside from being small, were normal. Six of these were raised by the mother (we destroyed the others at birth) and averaged 42 gm on the 21st day of age. As previously shown,[5] breeding of these precociously matured rats has no apparent deleterious effect. This particular rat subsequently raised four other litters; the number of young born at each succeeding parturition was 13, 10, 10 and 14, respectively. This rat, therefore, as the result of treatment with gonadotropic hormone while still immature as regards body size, gave birth to approximately twice the average number born under normal conditions. In our colony, the average litter size of untreated rats is 11.5, and 2 litters of 19 among several thousand have been encountered.

On the basis that 33 represents the maximum number implanted and 23 the largest number of young born, it appears that considerable resorption occurs. Evidently, however, not only can superfecundity be produced, but also the number of viable young carried to term can be increased above normal by treating immature rats with gonadotropic hormone. Our results indicate that the maximum prolificacy is obtained by treating rats just before the time of normal maturity.

H. H. COLE

UNIVERSITY OF CALIFORNIA,
DAVIS

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ADAPTABLE ROTATING UNIT FOR ROLLER TUBE TISSUE CULTURES[1]

To meet the problem of rotating roller tubes in a water-jacketed incubator an adaptable unit was devised. This unit can support either a simple test-tube holder or a Novy jar. By means of the latter a controlled atmosphere can be provided for the cultures.

The rotator is supported by a heavy steel base (A) 18 cm wide and 27 cm long. The inclination of the whole unit can be regulated by means of the screws (B) at the front edge of the base plate. The upright plate (C) supports the rotator shaft (D) by means of the bearings (E). The adaptable holder consists of a circular rear plate (F) joined to an anterior ring (G) by three sturdy supports (H). The three adjustable clamps (L) in the anterior ring hold the test-tube support or Novy jar in place (diagram 2). It is better for the anterior ring to be of a size snugly to fit the anterior lip of the Novy jar rather than for the latter to project, as in the diagram. By means of a standard double stopcock the jar can be exhausted or various gases can be introduced. The same holder can also be employed for an aluminum test-tube rack whose front disc fits a recess in the anterior ring of the adaptable holder (diagrams 1, 3, 4). A much larger test-tube support could be used with a unit having a shorter base plate (A). The rotator is driven by a small electrical motor[2] outside of the incubator

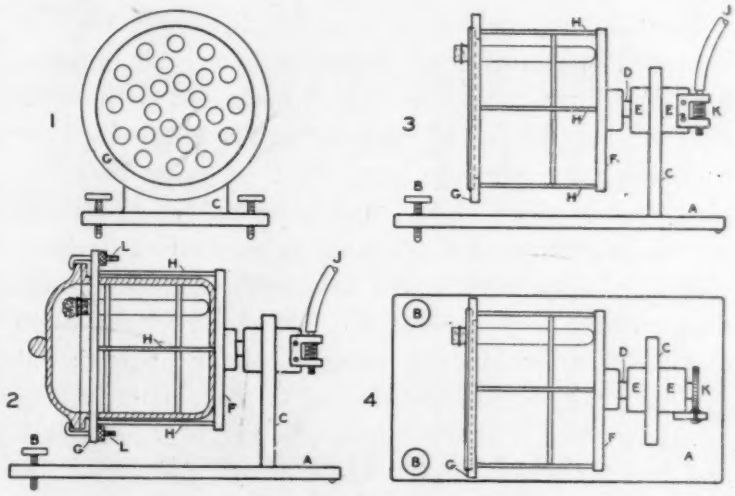


FIG. 1

[3] E. T. Engle, in "Sex and Internal Secretions," Williams and Wilkins Company, Baltimore, 1027, 1939.

[4] A prolonged gestation is frequently encountered in these precociously matured rats.

[1] This investigation was aided by a grant from the Jane Coffin Childs Memorial Fund for Medical Research.

[5] H. H. Cole and G. H. Hart, *Am. Jour. Physiol.*, 123: 589–597, 1938.

[2] Signal Electric Manufacturing Company, Menominee, Michigan. Type C2A 115 AC–DC Amp: 18 W15 Gear ratio 900–1.

connected to the unit by a flexible power cable[3] (J) that passes through the thermometer vent of the incubator. The gear ratio of the motor is 900 to 1. The cable is joined to the rotator shaft by a worm and gear (L) whose gear ratio is 50 to 1. The rotator makes about 10 revolutions per hour.

This arrangement is adapted when only direct current is available and it is necessary to keep the motor outside of the incubator, since heat is generated during its operation. Where alternating current is supplied a small synchronous motor which generates a negligible amount of heat can be attached directly to the shaft of the rotator by a suitable arrangement of gears.

LAWRENCE H. OTT
ROBERT TENNANT
AVERILL A. LIEBOW

YALE UNIVERSITY

A PERSONAL FILE OF GEOLOGIC PHOTOGRAPHS

A RECENT note on indexing and filing scientific photographs[1] seems to the present writer to cover only part of the ground, and it would be interesting to learn of the experience of various others. In 1919, the writer, in considering a plan of arrangement and storage for photographs, consulted with several persons in Washington and decided to deviate from the common custom of geologists then with the U. S. Geological Survey, in setting up a personal card file. The plan followed has served well for the arrangement, preservation and use of approximately 15,000 negatives and corresponding prints. Procedure is as follows:

Each lot of field negatives after development is arranged in the order of taking, and for each negative a 4- by 6-inch plain file card is made out with serial number (upper left); date (upper right)—in later experience the possible legal value of exact dates on photographs of water and vegetation has led to recording of the complete date; state or equivalent division (left); locality (right), and title, with as much specific data as may seem desirable. The serial numbers are chronological within any given block or project; but several projects that are carried on concurrently may be allocated to separate thousands, and it is not essential that these number blocks be filled. (Numbers are cheap.) The negatives are numbered and filed each behind the appropriate card. When prints are made, they also are filed behind the cards and are conveniently available for inspection or removal.

In the entire file, three sets of guide cards are used, with contrasting colors. One refers to serial numbers, another to dates and a third to regions or projects. For the use of an individual this chronological arrangement, rather than a strict subject or dictionary rearrangement, seems best, and by means of project and date it is easy to locate any particular series. It is admirably suited to maintaining a complete record of all one's photography, including the portion that may be done for official agencies. In the latter case, the filling out of the data card must likewise be done by the field man, and it may be retained in his personal file with a record print. At the proper time the negative and official prints may be transmitted into the official collection for any desired arrangement, the data being taken from the field man's personal file as originally composed from field notes. The latter work can all be done by office assistants.

Older parts of the file are in steel cases; current blocks are kept in light cardboard file boxes, which may be taken to the darkroom when printing or enlarging is done, or moved about in connection with work on a given project. Handling of field and laboratory negatives in such a file in no way prevents the subject arrangement of a display or file set of prints in the manner suggested by Trefethen, but it is an approach to the earlier, and in the writer's view, the more fundamental problem, the systematic labeling and preservation of original field negatives. This is important, for the scientist especially whose work is for successive agencies but who wishes to preserve the continuity of his own photographic record.

CHESTER K. WENTWORTH

BOARD OF WATER SUPPLY,
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[3] S. S. White Dental Manufacturing Company.

[1] J. M. Trefethen, SCIENCE, 91: 2349, 24, 1940.

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